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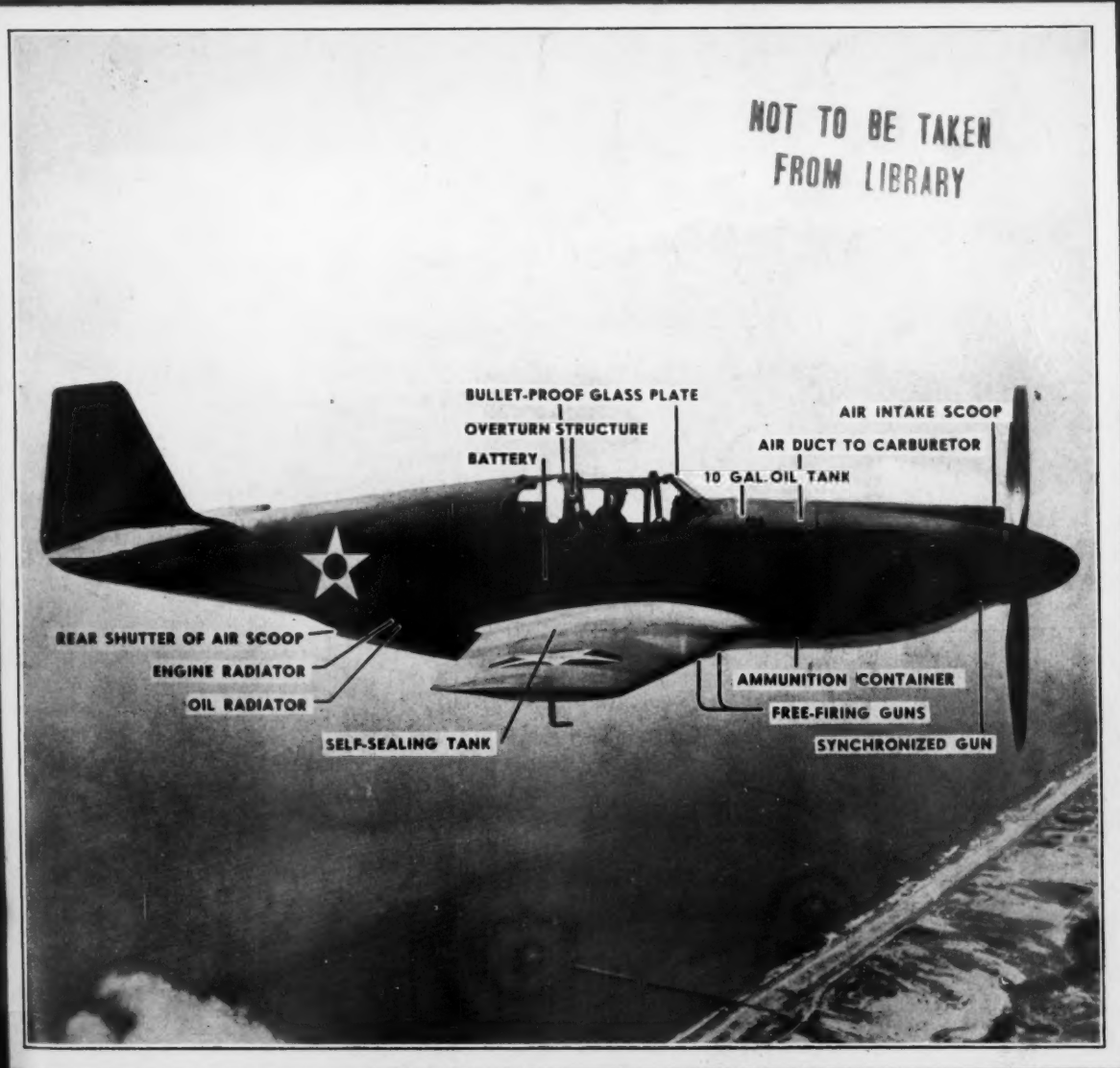

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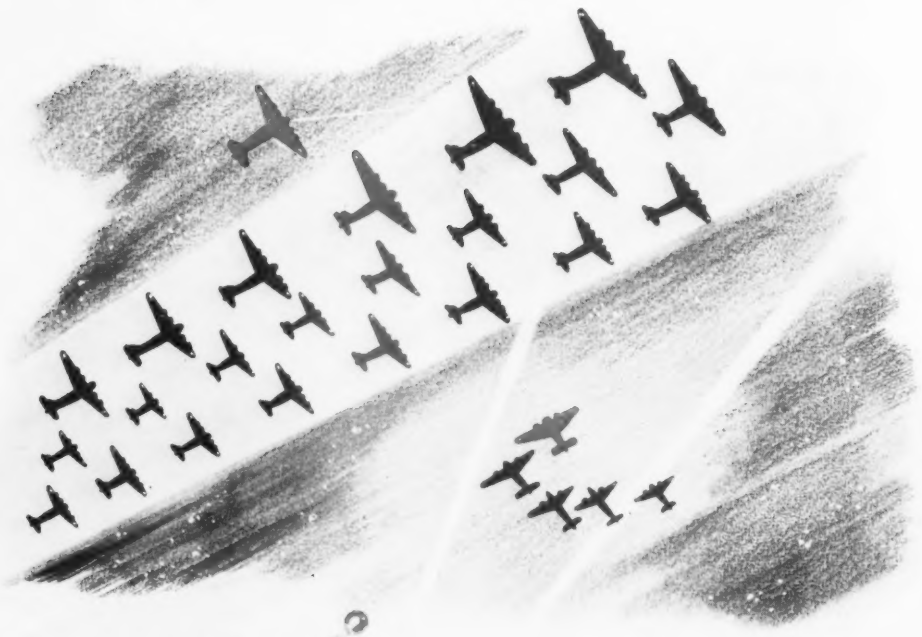

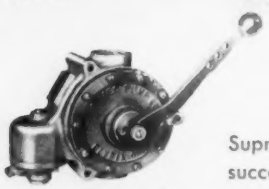

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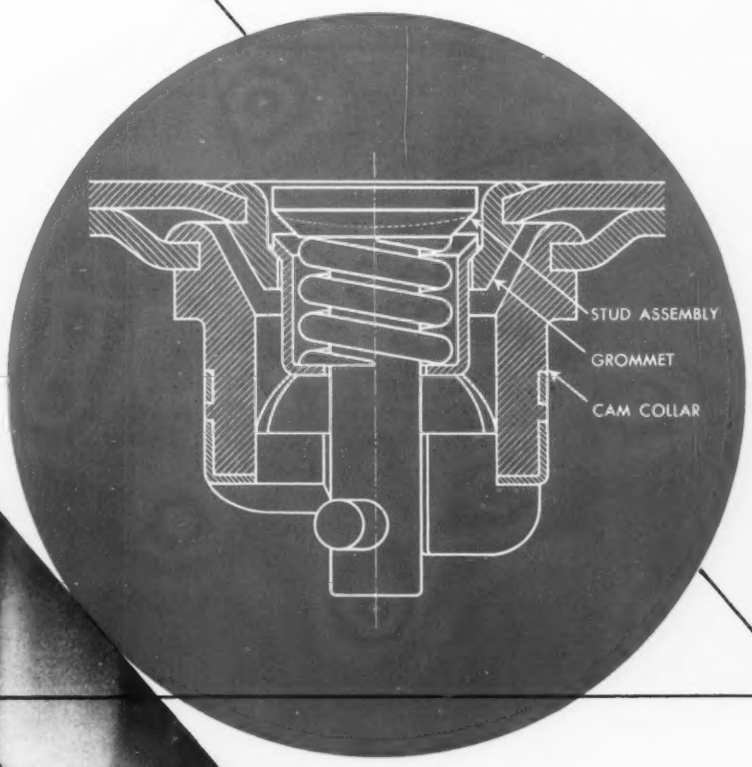

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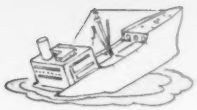

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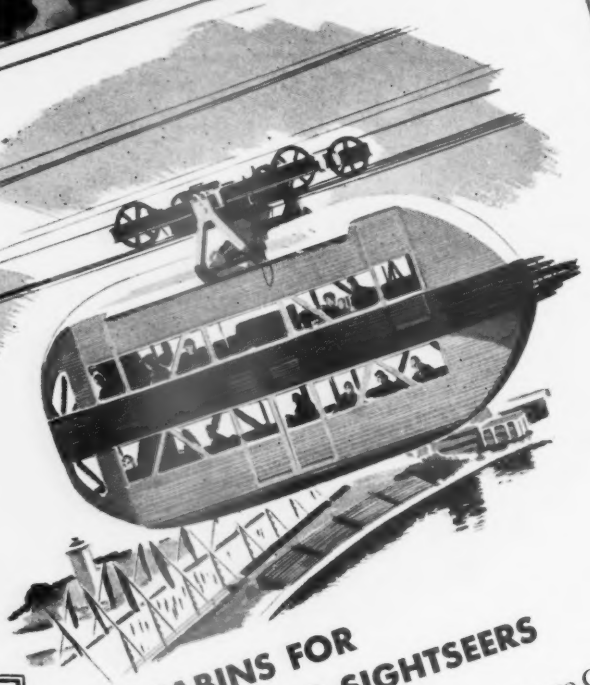
Trail Blazing in the Skies

1933



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The Aeronautical Engineer and Military Aeronautics

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THERE is a situation which appears to me to reflect both directly and indirectly on the contribution to military aeronautics of the aeronautical engineer as a class both in the research and applied phases of his work.

It would appear that in our intense efforts to produce large numbers of aircraft, we (meaning the American public from the top down) have seen only production lines and compilations of figures on aircraft delivery and have not looked behind all this to recognize and understand the high and typically American quality of the aeronautical engineering involved.

This is a strange situation, particularly in view of the fact that whenever high officials of our Government and armed services find it necessary to "Point with Pride" at some aspect of our defense situation, they point to very impressive aircraft production figures, or to our superior fiscal arrangements, or to very astute planning and foresight employed in shaping our approach to this conflict during the past several years. The *one* sure-fire evidence of American superiority which is pointed to with pride by orators and news commentators is the continually recurring display of the superiority in one respect or another of many of the American-built aircraft, as demonstrated in actual service. Government officials have not emphasized the high quality of American engineering. Apparently, it is taken for granted that our engineering, by some inherent Yankee attribute, is somehow superior to other brands.

It does not occur to anyone to consider that this material superiority is a product of many years of persistent effort by the members of a profession, most representatives of which are notoriously inarticulate and unable to stand up for themselves in the scramble for credit. Consequently, in this War, just as in peacetime manufacturing production, the engineer who creates the article and makes it salable has to take a back seat in favor of the salesman or the advertising executive who contributed nothing to the development and desirability of the article, but who are right on the spot when the credit is whacked up. The engineers are forgotten at this time, and plug along working up some new development for the boys in the front office to take for a ride. If business should get bad, the engineers are the first class of employees to be laid off. As one famous engineer said: "Who ever heard of Paul Revere's horse?"

All of the foregoing I have seen and resented for many years, and I think you can absolve me of any personal grudge in the matter, because I personally have fared very well and have received a great deal more credit for some of the things I have done than has been strictly due me. However, I do feel that there is enough evidence now in existence for engineers as a class to hope for a greater share of the credit which is now being centered on production lines and on the magic word "quantity."

Engineers are not after more money, shorter hours or closed shops but only a decent understanding and appreciation of the engineering preparation behind our aeronautical equipment of whose superior quality we see so much in print.

Somehow, aeronautical engineering has gotten into the dog house and has come to represent, in the minds of the impatient Public, obstruction and delay to production. This is due to our tendency to get mad at the nearest thing that displeases us. All engineers know that the only reason that engineering and development have held back production is because the services have invariably failed to authorize our engineers and research people to start soon enough and thoroughly enough, and have believed, in many cases, that we could undertake production before we had completed the necessary preliminary engineering. Hence, we have attempted to engineer, develop, and produce simultaneously, the result being that any delay in production which the engineer might have been forced to interpose even for the best of reasons was resented and gave rise to criticism not only of the engineers involved but indirectly of all engineering.

The production people have invented many wise cracks, such as: "We can't build airplanes *without* engineers and we can't get them built *for* engineers." This is very funny, but I think the time has come when somebody has to speak out and in no uncertain terms say that we are fed up with such oblivion and don't want any more of it. There is no field of military preparation in which the words "Too little and too late" apply more strikingly and bitterly than to engineering preparation in the aircraft field.

Our backwardness in this respect started in 1919 when we solemnly took away from the Germans all of their military aircraft and at the same time carefully preserved our own, even then, obsolete airplanes. From an engineering and development standpoint nothing could have been worse for us or better for the Germans. Immediately the Germans, being stripped of all old airplanes, turned to their progressive scientists and constructors, such as Junkers, Rohrbach, Dornier, Heinkel, etc. Starting with a clean slate, by 1926 these people had put Germany in an enviable position in the engineering development of aircraft.

Now look at the American picture. We carefully hoarded thousands of D. H. airplanes. These airplanes lasted physically for nearly 10 years, and the school of thought and design which they firmly fixed in the minds of service people and the aircraft industry in general survived for many years more in the shape of simply further editions of the old D. H. airplane dolled up with new names and paint. All this time aeronautical research and development which were greatly needed in that era of aircraft development could not find the support of public funds for their vigorous and planned prosecution. The fact that the United States Air Services, both military and naval, actually had on hand numerous new airplanes presumably suitable to conduct the sort of operations that had been developed in the past war was sufficient reason to cease worrying about future development. Here is a fine example of complacent belief in the security of a large number of airplanes without bothering to think that these airplanes were worthless from modern operational standpoint.

Aeronautical engineering in its military aspects has been pushed around long enough and it is time it receives the credit due it for its important part in our war effort.

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Vultee Radio Recorder

HARVEY D. GIFFEN

Consolidated Vultee Aircraft Corporation

ABSTRACT

In order to obtain essential engine and airplane flight performance data on prototype airplanes, Vultee Aircraft, Inc., has developed and built the Vultee Radio Recorder.

This recorder consists of a system capable of converting physical stimuli into related audio frequencies that modulate the carrier wave of the airplane transmitter.

The transmitted instrument signals are picked up at a ground station and are recorded and decoded. The amplitude of a total of 72 different instruments such as strain gauges, temperature bulbs, pressure units, and flight instruments can be taken at a maximum speed of $^1/_{100}$ sec. per instrument. The use of varying audio frequencies to represent instrument deflection overcomes amplitude variations in the radio carrier wave due to fading and produces a permanent record in a form that lends itself to automatic chart plotting. An automatic analyzer that decodes and produces separate charts for each instrument is described. The system gives permanent records of all flight test data at a considerable saving in flight and engineering time.

INTRODUCTION

THE DETERMINATION of performance of airplanes and aircraft engines in flight is a problem that is increasing in both magnitude and importance. Under present war preparedness conditions the additional factor of time is vital, since rapid production demands all the information possible on prototype aircraft and engines in a short test period.

Modern design practices have produced aircraft and engines of remarkable efficiency, yet the determination of the true performance of these new models and where they can be further improved depends largely on the ability to obtain accurate flight test data.

A minimum of from 50 to 100 factors are involved in determining the performance of the airplane or engine in today's aircraft. These factors include, in addition to observation of regular flight instruments, many temperature and pressure readings, atmospheric conditions, fuel flow, vibration, and records of throttle, flap, and control positions and loads. As most of these factors are variables, it is necessary that readings and recordings be taken rapidly in order to obtain a true picture of performance.

The problem of obtaining flight test data is further complicated by the fact that some of the airplanes being studied are single-place military pursuit ships having no available space for an observer and little space for test equipment.

Faced with the aforementioned problems, Vultee Aircraft designed and built a system for high-speed recording and analysis of flight test data. This system is designed to respond to various stimuli from pressures, temperatures, strains, and movement by means of special pickups; to scan these pickups at a maximum rate of 100 readings per sec.; and to transmit these indications to the ground by radio where permanent recordings and analyses are made.

RADIO TRANSMISSION

The advantages of using radio transmission are obvious. In flight testing new type airplanes it is not unusual to lose a ship in a crash, and too often the cause of the failure cannot be determined. With flight test data transmitted to the ground by radio and recorded, a permanent record of what has happened is available and might prevent a duplication of accidents. In addition, space requirements in many airplanes prevent the use of recorders of sufficient capacity to handle the required number of pickups. The most important advantage of radio recording in flight testing is that instruments can be instantly charted on the ground and observed by a number of engineers and that the pilot can be advised of existing conditions during the entire flight.

The radio recorder uses the existing radio transmission equipment on the airplane being tested, or it may use an auxiliary transmitter on any band suitable for voice communication. In cases where only one transmitter is available on the airplane being tested, the pilot can alternately switch from normal communication to the radio recorder instrument signals.

The disadvantages to date of radio recording have been (1) fading of the radio signal, (2) decreased range of operations, and (3) interference due to static. The problem of fading has been overcome by converting the amplitude readings of the various pickups into audio-frequency modulation that cannot be changed by amplitude variations in the radio carrier.

The problem of range is met by confining the flights to a radius within which normal radio communication can be maintained, approximately 100 miles.

Static interference with instrument readings does not affect analysis unless continuous static totaling more than 30 per cent of the signal is present. Limiter circuits similar to those used in frequency modulation receivers remove the static from the signal.

FLIGHT EQUIPMENT

The recorder consists of equipment carried in the airplane which scans the various pickups and converts their readings into corresponding audio-frequency oscillations, which are fed into the microphone input of the airplane transmitter. The ground equipment receives these signals and records them by several methods: sound film, disc recorder, and graphic recorders.

The equipment in the airplane consists of the pickups; the scanning switch, which weighs 12 lbs. and occupies approximately $^3/_4$ cu.ft., and the converter unit, which weighs 15 lbs. and occupies approximately 1 cu.ft.

The pickups are all of special design, so constructed that all variable factors involved are automatically cancelled out except the factor to be measured. Each pickup with its leads forms two arms of an a.c. bridge. The temperature pickups, Fig. 1, are of the resistance type constructed to follow rapid changes in the medium being measured. They consist of a thin copper tube, a thermal insulator of special cement, the resistance wire winding, and a thin copper plating over the winding. The use of all copper parts in the construction prevents the introduction of errors due to mechanical strains from expansion and

Presented at the Radio and Instruments Session, Eleventh Annual Meeting, I.A.S., New York, January 25–29, 1943.

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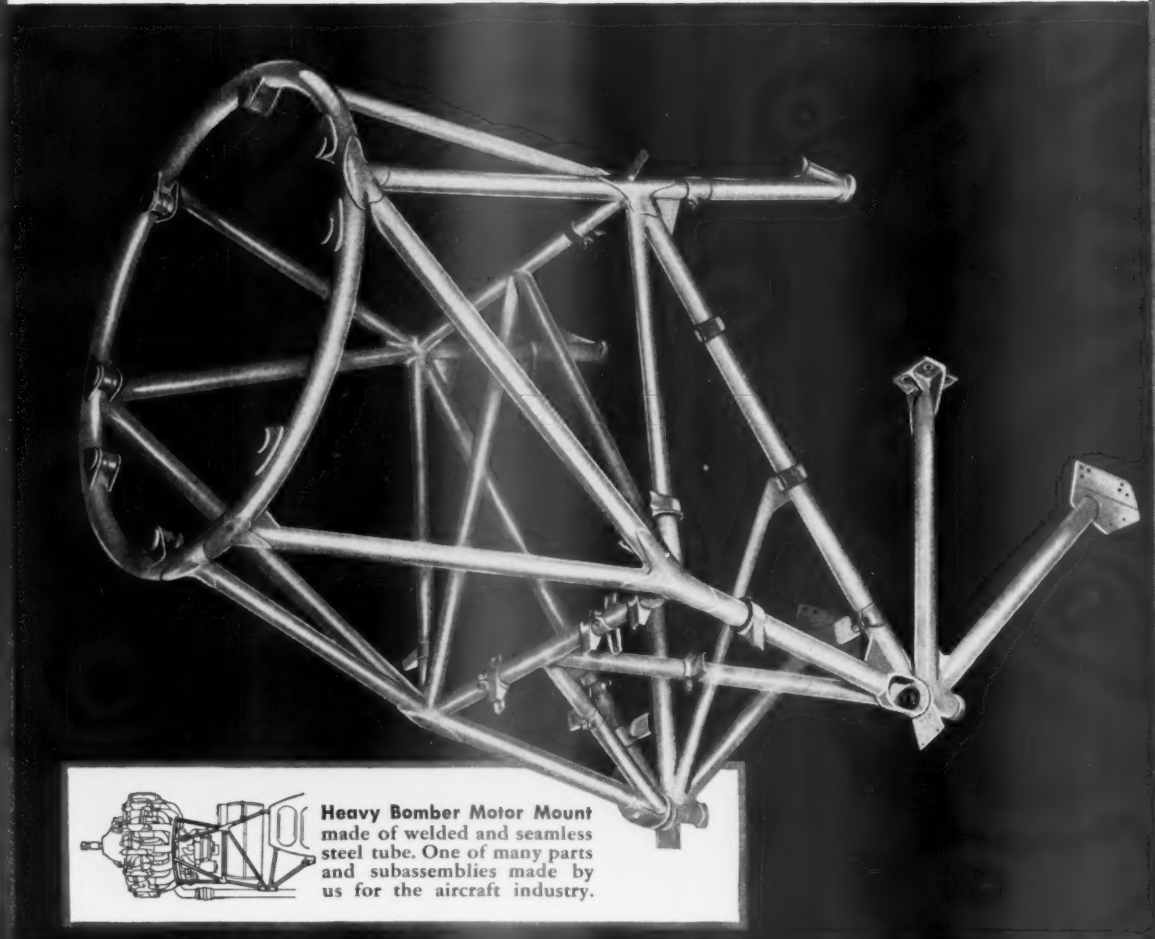

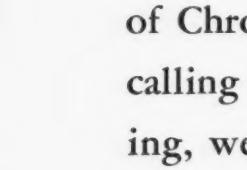

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contraction of the unit. The unit is connected into the bridge as shown in Fig. 1. For high-temperature measurements such as encountered in exhaust gases, a similar unit is used except that the materials used are stainless steel and platinum wire.

Strains are measured by means of a standard type wire wound strain gauge, Fig. 2, and an unstressed dummy gauge mounted adjacent thereto, which, with the leads, forms two arms of the bridge to cancel out the effects of temperature.

Positions of controls or control surfaces, Fig. 3, are measured by suitable leverage systems operating a potentiometer.

All pressure units, Fig. 4, use standard diaphragms. The movement of the diaphragm causes a small armature to move between two coils that form two arms of a reactance bridge.

Reactance bridges are also used in other than pressure units, such as for measuring deflection of a spring in a push-pull flight control rod, Fig. 5, or the movement of an instrument element, such as in gyroscopic instruments. Each pickup and its leads form two arms of a bridge that is connected by the switch to the other two bridge arms built in the converter, Fig. 6.

Tachometers used with the Vultee Radio Recorder are frequency generators and will be discussed later.

These various pickup bridges, Fig. 7, are energized by an a.c. generator "C" and are scanned in rapid succession by the switch "B." The amplitude of the bridge carrier is changed or modulated by the gauge under influence of the stimulus being measured, causing a change in amplitude of the bridge carrier "D." This is amplified at "E" and rectified at "F," producing a large d.c. amplitude change corresponding to the change in gauge "A." The d.c. "F" is fed into the control grids of a pair of reactance tubes that act as part of the capacity and inductance of an oscillator circuit "H" which varies in frequency between 4,000,500 and 4,005,500 cycles per sec. in accordance with the amplitude of "F," giving a frequency modulation "G" as shown. This varying frequency beats against the fixed frequency of oscillator "K," which causes a beat note "J" between 500 and 5,500 cycles. The audio signal "J" is then fed into the microphone line of the airplane transmitter.

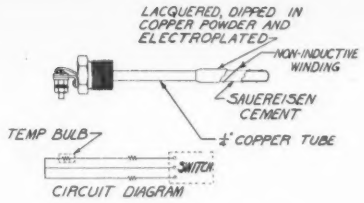

Fig. 1. Temperature bulb.

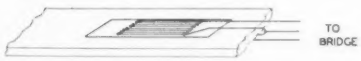

Fig. 2. Strain gauge.

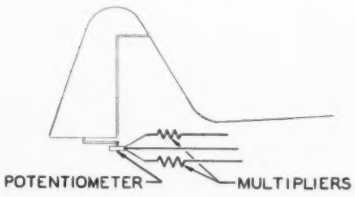

Fig. 3. Angular measurement.

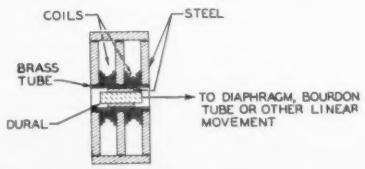

Fig. 4. Reactance bridge coil.

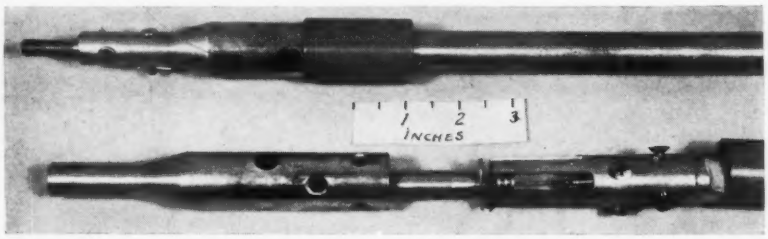

Fig. 5. Push-pull flight control rod.

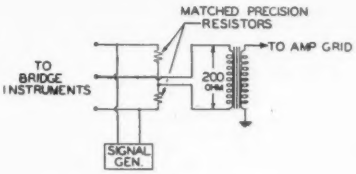

Fig. 6. Bridge diagram.

Ground Equipment

The transmitted signals are picked up at the ground station and recorded, a disc recorder being used in most cases to make a master record as a safety measure in case of failure of any of the other instantaneous recorders or of the decoding apparatus. In addition, the signals can be decoded electronically and recorded on paper charts, the chart width and accuracy depending on the speed of the scanning switch in the airplane. In power-plant studies, where readings taken at the rate of one instrument per second are satisfactory, direct paper charts of 6 in. width can be made as the signals come in by using a standard commercial graphic pen and paper recorder.

In strain studies, such as load distributions during maneuvers of the airplane, the readings may be made at a rate of 100 per sec. with signals recorded on both disc and film. These recordings may be made either simultaneously or the film may be re-recorded from the disc.

The decoding of the recorded signals on the film, Fig. 8, and the identification and the plotting of the readings of each pickup on a separate chart are automatically accomplished by the analyzer. This consists of a means of projecting each image of each instrument signal through an optical scanning system that determines the frequency of the recorded signal and then plots the related amplitude on a pen and ink chart. In addition to converting the frequencies to their corresponding amplitudes, the analyzer moves the correct chart for each pickup into the proper recording position when the film image of that pickup is moved into the decoding system. The changes in the stimulus for each pickup are thereby plotted on a separate chart. Approximately 3 sec. are required per indication to accomplish this automatic decoding and plotting.

Calibration

In present operations a change of 5,000 cycles per sec. for the total range of each instrument has been arbitrarily chosen as full scale. Each pickup is therefore designed to cause a 5,000 cycle per sec. change in the converter unit when the pickup is subjected to the maximum change in stimulus which it is required to measure. The graphic recorders are used as frequency meters, responding full scale to 5,000 cycles per sec. change. Therefore a strain gauge having a range of 50,000 lbs. per sq.in. and subjected to a 10,000 lb. per sq.in. load will produce a change of 1,000 cycles per sec. in the converter unit and will be plotted at one-fifth full deflection on its chart. An air-speed pickup designed for a 500 m.p.h. range will, when the ship is flying at 100 m.p.h., cause a frequency change of 1,000 cycles per sec. in the converter and will be charted at one-fifth full deflec-

BOMBS AWAY!

You can count on G-E BOMB-DOOR DRIVES to deliver the "eggs"

THE PUNCH you need—when you need it—has been built into the G-E bomb-door drive shown below. Careful design, fine materials, and rigid tests have all contributed to making this power package one that will stand up under the toughest combat conditions. For example, one of the many outstanding features of this G-E power package is the winding structure which—because of a superior new insulating technique—is practically indestructible under the severest overloads.

TO DESIGNERS

For complete information about G-E aircraft electric motors, send for our new catalog, GES-3108. *General Electric Co., Schenectady, N. Y.*

G-E power packages include an electric motor and such accessories as magnetic brake, reduction gears,* and friction clutch. For driving bomb doors, wing flaps, and landing gears.

*Reduction gears manufactured by Pacific Gear Works, Los Angeles.

POWER PACKAGES

GENERAL ELECTRIC

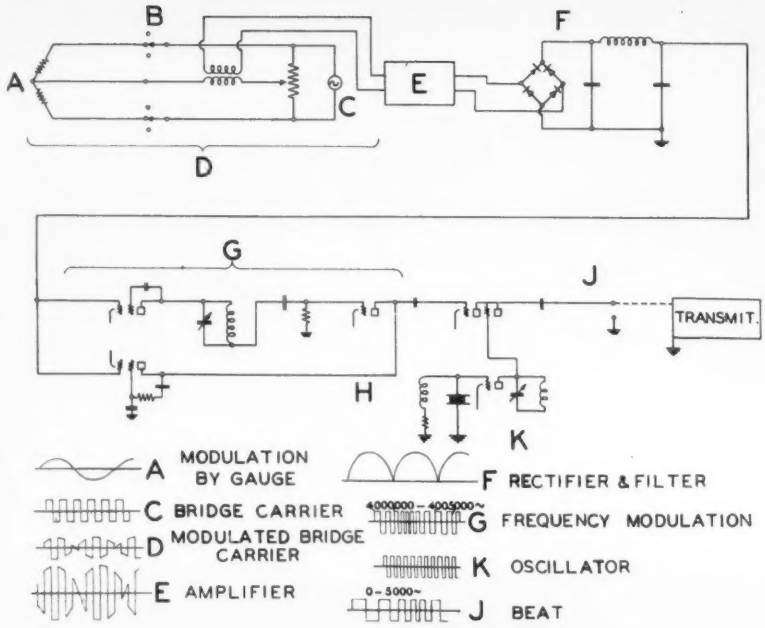

FIG. 7. Schematic wiring diagram.

FIG. 8. Recorded signal on film.

tion on a similar chart calibrated at 500 m.p.h. full range.

As an additional accuracy control on the system, two dummy gauges are included among the active gauges on the ship. These are designed to produce 1,000 and 5,000 cycles per sec.—i.e., a 4,000 cycle per sec. spread between them in the converter unit. These gauges furnish a check and a control on the entire system. If any variation should occur in the equipment in the airplane due to changes of power supply, temperature, or weak tubes, the 4,000 cycle per sec. spread when charted will indicate the change. This change can be corrected immediately by an adjustment on the analyzer. Therefore all variables in the pickups, the converter unit in the airplane, and the analyzers have been either automatically cancelled out or recorded so that both time and amplitude of their occurrence are known.

The instrument frequency when recorded on film can be projected, and the cycles per second can be determined to an average accuracy of 1 part in 250. If a large number of such determinations are required, the work can be facilitated by projecting the instrument frequencies on a revolving drum calibrated in cycles per second. As this method is slow it is used only for check calibrations or in cases where extreme accuracy is desired. In normal operations, automatic analysis is used for all readings wherever an overall accuracy of ±1 per cent is satisfactory.

Strain Gauges

The strain gauges used have a resistance of 88 ohms and vary 2 ohms over a range from −60,000 to +60,000 lb. per sq.in. stress in 24ST aluminum. When it is desirable to measure small loads under special conditions, the converter unit can be made to swing through its entire range by increasing the gain on the bridge amplifier so that strains can then be read over a total range of approximately 3,000 lbs.

Range Control

As other types of pickups are more sensitive than required, shunts or multipliers are used in normal operations to control their ranges. In the case of temperature measurements, Fig. 1, the units are made to approximate specification ranges and then, by the use of proper multiplier resistances in series with the unit, the ranges are adjusted exactly as desired. The initial temperature units made for this equipment consisted of windings of alloy wire on cores of different materials, but these were found to be unsatisfactory because of mechanical strains on the resistive element which were caused by unequal expansion and

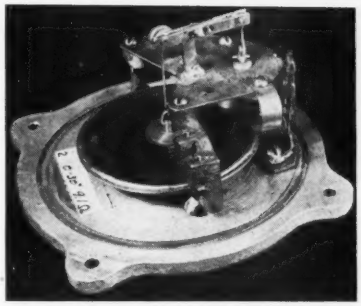

FIG. 9. Typical pressure unit.

contraction of the parts. The present units are single layer windings approximately 1 in. long of No. 36 copper wire on a thin core of copper tubing. The resistance versus temperature characteristic of this unit is a straight line—whereas such units made of a combination of different metals resulted in nonlinear relationships or, in some cases, in reversals in the response characteristics. A standard temperature unit for 150°C. range contains approximately 4 ohms of No. 36 wire in series with 100 ohms of zero temperature coefficient resistance in its arm of the bridge. The amount of resistance used in the other arm of the bridge determines the zero of the range. That is, if 104 ohms is used with all values taken at room temperature of 20°C., the bridge will balance at 20°C. and will cause a frequency output from the converter of 500 cycles per sec. When the temperature at the pickup is increased to 170°C., the converter frequency will become 5,500 cycles per sec. If, however, it is desired to measure from −70° to +80°C., the same unit can be used with 100 ohms in series with the active unit and 100 ohms plus the resistance of the unit at −70°C. This would cause the bridge to balance at −70°C. and would provide a frequency of 500 cycles per sec. at −70°C. and a frequency of 5,500 cycles per sec. at +80°C. In actual operation, units are set to measure the desired ranges, and individual chart calibration strips are prepared for each unit. These strips are attached to the final charts from the analyzer, thereby using the entire chart width for all pickups regardless of their respective ranges. This is true because each unit and the graphic recorder cover the same frequency spread.

Pressure Units

The same conditions of flexibility exist in the pressure units. A given diaphragm using the same reactance coils can be used to record full-scale charts on ranges of 0 to 20 in. H_2O, 0 to 30 in. H_2O, 0 to 60 in. H_2O, or 0 to 10 in. Hg. This is accomplished, Fig. 9, by selecting a leverage fulcrum that will give ap-

"We feed these babies with a measuring spoon!"

THE modern aircraft engine has the power to move a freight train. Yet it weighs less than a pair of ordinary car wheels. The secret of its tremendous output without the need for massive parts lies in large measure in microscopic balance, high speed, and high efficiency, together with the miracle of modern alloys. Its power is smooth and tremendous when under instrument control . . . but is gone in a flash—along with a plane and a pilot, perhaps—if it is ineptly handled. Kollsman engine instruments—tachometers, manifold pressure gages, thermometers—are what give the pilot control over the torrent of power which propels him through the skies. Upon their precision and reliability has been built not a little of aviation's current advancement. Their role in tomorrow's progress is an even greater one.

WHAT TOMORROW'S AIRCRAFT ENGINES *will look like or how they will perform, we don't know yet. But we do know that instruments will play a large part in expanding their scope and usefulness far beyond anything we know today. Kollsman engineers are constantly developing new and better aircraft instruments which will help widen and extend tomorrow's skyways for a new era in aviation.*

THE KOLLSMAN ELECTRIC DUAL TACHOMETER AND SYNCHROSCOPE *not only registers engine revolutions in twin-engined planes, but directly compares the speed of the engines to permit perfect synchronization. It is electrically operated, with generators on the engines sending power impulses by wire to the indicators on the instrument panel.*

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

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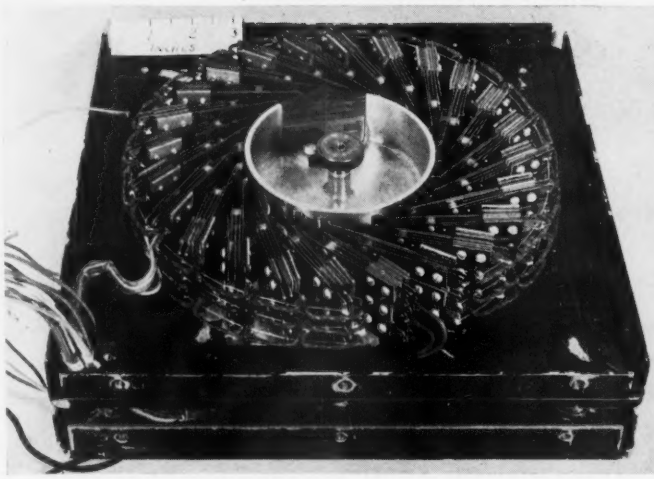
ELMHURST, NEW YORK GLENDALE, CALIFORNIA



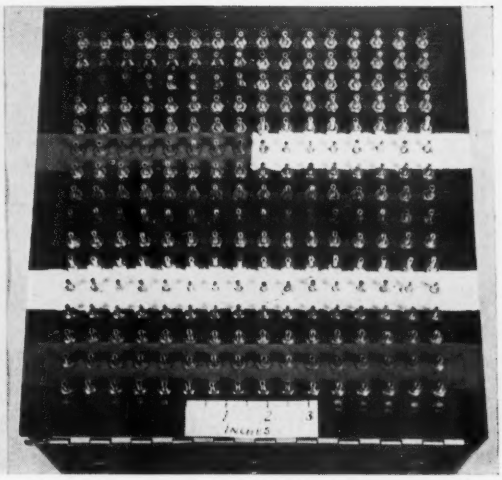


FIG. 10. Scanning switch. FIG. 11. Terminal board.

proximately full armature movement for the diaphragm deflection at the required range. The maximum unbalanced condition of the reactance unit is then shunted with sufficient resistance to cause the bridge unbalance to activate the converter to 5,500 cycles per sec. The standard reactance unit, Fig. 4, used in most of the Vultee Radio Recorder pickup units consists of two coils each $^3/_4$ in. outside diameter times $^1/_{16}$ in. long having equal inductance (approximately 1.5 millihenries) wound on a $^1/_4$-in. copper tube and separated and covered by $^1/_{16}$-in. iron casing.

When coils of equal inductance are used, the armature extends from center to center of the coils in balanced bridge condition and moves $^1/_{32}$ of an inch to maximum unbalanced condition. In this latter position the armature completely closes one coil and opens the other. Some pressure instruments have an excessive diaphragm movement, in which case the zero bridge balance condition is obtained by the armature completely closing one coil and opening the second coil which is wound with the correct number of turns to produce an inductance equal to that produced by the first coil closed by the armature. In this case maximum unbalanced condition is obtained by moving the armature a distance equal to the width of one coil instead of only half the width as in the case of balanced coils. The armature in all cases is an iron sleeve mounted on an aluminum core and is of such small mass with respect to the diaphragm forces that vibration effects on the unit may be neglected.

Position Indicators

The calibration of position indicators can be accomplished by both mechanical and electrical means. Wire wound potentiometers of suitable values are used with multiplying resistors to give the correct range. Mechanical systems are designed to use 50 per cent or more of the available rotation of the potentiometers.

Tachometers

Tachometers are multipole alternators designed to convert the desired range of r.p.m. into a related range of cycles per second which falls within the established frequency swing of the radio recorder. The output of the tachometer unit is fed through the scanning switch to the radio transmitter as audio modulation.

The number of poles on the tachometer unit is determined by the range of r.p.m. to be scanned. Example: Records of engine speeds between 500 and 4,000 r.p.m. are desired. Since the tachometer shaft rotates at one-half engine speed a 120 pole generator would, at an engine speed of 500 r.p.m., produce 500 cycles per sec. and at 4,000 engine r.p.m. would produce 4,000 cycles per sec. This generated signal can then be recorded and analyzed by the same methods used to record and analyze the signals from the converter unit. The frequency generators used with the radio recorder consist of a steel gear whose teeth pass the pole of a permanent magnet. In the above example a 120-tooth gear would be used.

The Converter Unit

Since all pickups are set to a "common denominator," calibration of the converter unit is accomplished by setting the gain of the bridge amplifier to produce the desired frequency swing. For ease of calibration, this "common denominator" has been fixed as the amount of change on the output of an equal arm bridge (100 ohms in each arm) when one of the arms is changed 2 ohms. The normal frequency swing of the converter is set at 5,000 cycles per sec., permitting the operation of the automatic analyzer at any points between 500 and 6,500 cycles per sec.

This flexibility of frequency shift in the analyzer affords primarily a safety factor to be used in case the basic zero of the converter drifts from its set frequency. Should a drift of the basic frequency be encountered, there is available on the analyzer a correcting adjustment that permits the charts to be plotted on the basis of 5,000 cycles per sec. change equal to full scale, regardless of whether the 5,000 cycles per sec. is between 500 and 5,500 or between 1,500 and 6,500. The charted output of two dummy check gauges in the airplane serves as an indication of, and as a correction for, both frequency drift and frequency spread. In case of a change in frequency spread between the two dummy check gauges, there is available on the analyzer another adjustment to hold its calibration to the correct spread as indicated by the plotted output of the check gauges. The relation of all pickups to each other and to the check gauges is fixed in the laboratory by applying known changes in physical stimuli by accepted laboratory methods commonly used in instrument calibration. Since these methods are generally standardized, they will not be described in this paper.

Summarizing the entire calibration, it may be stated that all pickups are laboratory calibrated in relation to fixed gauges. Any changes occurring in other parts of the equipment are corrected at the analyzer so that the fixed dummy gauges appear on the charts in their correct ratio, thereby assuring the correct ratio for all other pickups. In other words, 0 to 5,000 cycles per sec. swing = full chart scale = any desired stimulus range.

Scanning Switch

The scanning switch in present use is the result of considerable research in rapid switching. Various types of wiping contacts were investigated and found to be unsatisfactory at high speeds because of vibration. The present type switch, Fig. 10, consists of leaf type contacts actuated by a cam. One arm and the amplifier input of each bridge pass through the switch, while the opposite arm is connected directly to a converter connection common to all pickups. The leaf switches are so adjusted that the arms of the bridge are completed before the amplifier input contact is made, thereby preventing overloading in the amplifier while the bridge is open on one arm. The tangential arrangement of the switches with respect to the cam allows the actuating arms of the leaf switches to ride on the small circumference of the cam, thus suppressing vibration and bouncing. The actuating cam is designed to give uniform pressure on the switch while in contact. Speed changes in scanning are accomplished by electrical control and by changeable gears mounted on the outside of the switch box. The present switch contains 72 contact point sets mounted in three banks of 24 each. Any one of the banks may be scanned continuously or two or three banks may be scanned in succession. This is accomplished by associated gear trains and electric plug-in jacks.

In addition to scanning the pickups, the switch, by means of additional gear trains and contact points, stops the signal from the converter during the intervals between each instrument reading, Fig. 8. This unmodulated section serves as a division between instruments during analysis, while on film recordings the black part of the unmodulated track is used as a framing mark in the analyzer and operates an automatic photocell framing device. For opening the signal line from the converter during the time a tachometer signal is coming through, special contacts are also provided. All contact points of the switch are wired to one side of a plug and jack terminal board, Fig. 11, on which any desired sequence of instrument readings may be arranged.

Optical Analyzer

The conversion from changes of stimuli to changes of frequency in the converter unit in the airplane can be considered instantaneous because the entire process is electronic. The speed of decoding these frequencies and plotting them on charts must be controlled by the time element imposed by the mechanical devices used. While the amplitudes in flight can be taken as fast as 100 per sec., the automatic analysis and plotting on separate charts of the recording made at this speed require three or more seconds per instrument. The optical analyzer consists of a means for projecting successively each instrument frequency, Fig. 8, as recorded, through a scanning mat and to a photocell. The term "instrument frequency" refers to the one group of striations. The scanning mat, mounted on a revolving drum, Fig. 12, consists of a transparent film on which is recorded a continuous sound track that varies from 500 to 6,500 cycles per sec. As the scanning image passes across the stationary image of the instrument frequency, a low amplitude modulation of the light beam is produced. At the moment the scanning frequency matches the projected instrument frequency, the two images are superimposed and thus pass the maximum amount of light. They next become adjacent to each other and shut off all of the light. This alternating sequence produces a surge of high-amplitude light modulation which, through the phototube and associated circuits, operates the graphic charting equipment. The sequence of charting operations automatically performed by the analyzer is as follows:

(1) Without contact, the recording pen moves across the chart in relation to the rotation of the scanning mat.

(2) Matching surge causes the pen to strike the paper.

(3) Pen returns to zero.

(4) Endless chart belt moves ahead to the chart for the next instrument.

(5) Film moves ahead to the next instrument frequency.

(6) Cycle starts over again when No. 4 and No. 5 are complete.

To prevent premature operation of any part of the analyzer interlocking relays are provided.

If 72 instruments are scanned in the airplane, an endless belt of 72 charts is used in the pen recorder. After the decoding is completed, the charts are cut apart to give a separate chart for each instrument with all charts covering the same flight time element.

Instantaneous Graphic Recording

When the radio recorder is operated at speeds not exceeding the mechanical lag of the paper recording equipment used, direct paper charts of the instrument readings can be made at the ground station as they are scanned in the airplane.

The Esterline Angus Graphic Recorder used with the analyzer can be used for plotting the instrument readings, provided they are scanned at a rate of not to exceed one reading per second, which is the time lag of the recording pen. The decoding in this case is accomplished by means of electronic circuits. The transmitted instrument frequencies are fed from the radio receiver into a limiter circuit which keeps the amplitude of the signal constant during input variations of from 15 to 25 volts. The signal is then fed to a discriminator circuit that produces a direct current varying in proportion to instrument frequency. This direct current is used to operate the meter element of the graphic pen.

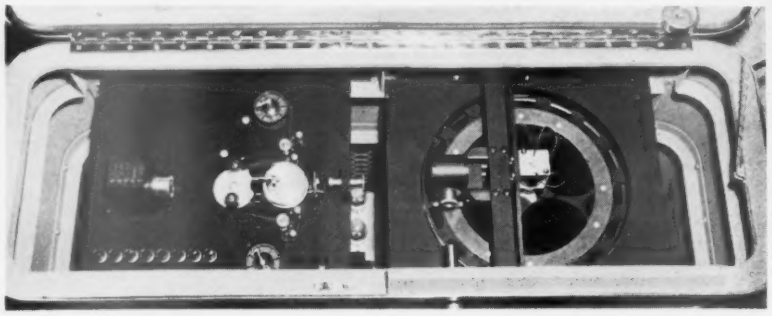


Fig. 12. Automatic film analyzer.

In addition to the electronic analysis, a disc record is cut as the signals are received. The recording serves as a permanent record of the flight and a safety record in case of failure of the graphic instruments. A standard commercial disc recorder is used with changes made to insure freedom from recording noise and speed variations. Crystal units have been substituted for magnetic. The records are cut at $33\frac{1}{3}$ r.p.m. with 130–140 lines per in.

The disc recorder is mounted on a cabinet containing the limiter circuit, the discriminator, amplifier, speaker, amplitude indicator, and amplitude control. Jacks are provided for input and output to various recorders. A microphone is provided for recording identification and other data desired on the record to compliment the instrument signals. The records can be played back and re-recorded on film for analysis by the optical analyzer or the graphic recorders.

The B.F. Goodrich Airline of the month

EASTERN *Air Lines*

HIGHLY GEARED to the business of all-out war, Eastern Air Lines are doing a tremendously vital job. Night and day their great Silverliners and the transports they operate for the U. S. Army are speeding freight, essential civilian travelers, and military personnel over a sky route that blankets the eastern third of the United States.

Many B. F. Goodrich products fly with the Silverliners. De-Icers crack off any ice that forms on wing and tail surfaces. Expander Tube Brakes improve ground control and help bring planes to safer, smoother stops. And B. F. Goodrich Silvertown Tires mean safer landings and take-offs with capacity loads.

For the vital part they're playing in the war effort and for their many contributions to the advancement of commercial aviation, B. F. Goodrich nominates Eastern Air Lines as "Airline of the Month."

In war or peace

B.F.Goodrich

FIRST IN RUBBER

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*

WARTIME AVIATION LEADS TO NEW TIRE DEVELOPMENTS

ONLY A SHORT WHILE AGO, aviation's modest needs were well supplied with only a few types of properly engineered tires. Most important of these, both then and now, was a low pressure tire that was tough, yet with plenty of cushioning for transport and private planes.* High pressure tires that were light and compact were available for Navy deck landings and similar services.

But today, as global warfare has carried our planes into jungle terrain, desert sands, and arctic "snow ports," it has been found necessary to develop many new kinds of tires. Here are some of the landing problems and the tires B. F. Goodrich engineered to meet them:

PROBLEM: To provide fast military planes with a wider braking area for quicker, surer stops on all types of landing fields.

SOLUTION: A larger bead diameter was provided in the B. F. Goodrich Smooth Contour Silvertown. Thus, larger wheel rims and greater braking surface were obtained. The wide footprint and non-skid tread of this tire meet the need for maximum ground contact and stability.

PROBLEM: To stop fast planes more quickly and efficiently on icy runways and to take off without skidding.

SOLUTION: Steel coils bonded to the rubber during vulcanization and running around the circumference of the tire bite into the ice and stop the plane quicker, or give ready traction for all ground maneuvers. The new B. F. Goodrich Winter Silvertown is the result.

PROBLEM: To develop a small solid auxiliary wheel for airport operations that would keep cool, even in hot climates and when excessive taxiing cannot be avoided.

SOLUTION: A solid tire in which the tread is *vented.* Venting goes half-way through the sidewall and half-way through the tire, with alternate rows of vents on opposite sides. Some sizes have the aluminum casting vented for extra heat dissipation.

PROBLEM: To provide a tire with High Pressure characteristics, yet which would provide extra ground contact on improvised emergency runways.

SOLUTION: The B. F. Goodrich Channel Tire is built with a high, almost square shoulder that gives a wide, ground-hugging footprint.

PROBLEM: To be ready with the "know how" to build *airplane* tires of synthetic rubber.

SOLUTION: Synthetic airplane tires were made and tested by B. F. Goodrich and approved by the Civil Aeronautics Administration on March 5, 1943, for use on the air lines.

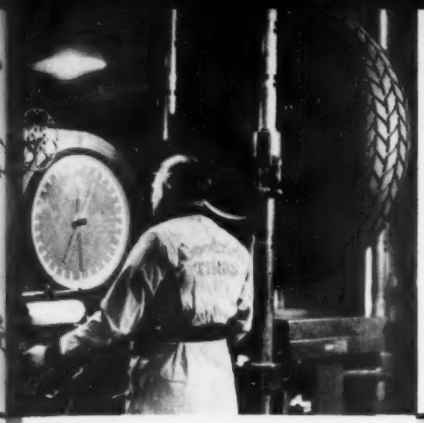
**The first low pressure airplane tire was developed by B. F. Goodrich engineers, and has become the most famous airplane tire in flying history. It's known as the B. F. Goodrich Low Pressure Silvertown.*

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

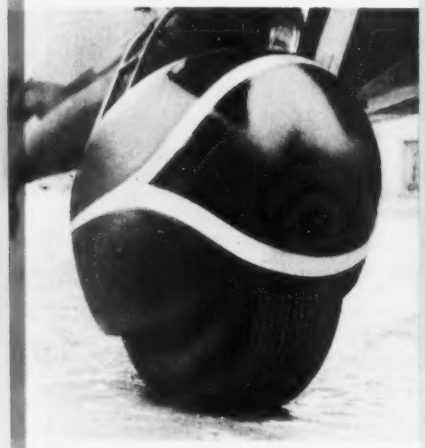
ARMY (E) NAVY
Awarded to seven plants

These tires meet the Challenge of

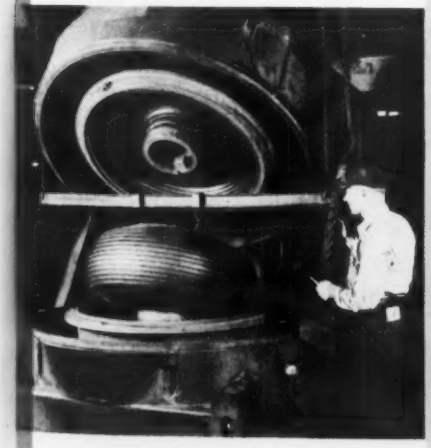
GLOBAL WAR IN THE AIR



1. Here is the Smooth Contour Silvertown, in the B. F. Goodrich testing laboratories. All smooth contour landing wheel tires for military planes have non-skid tread.

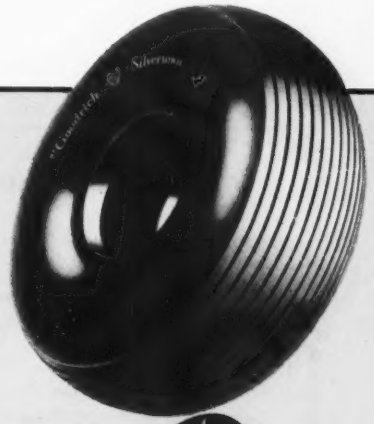


2. The B. F. Goodrich plane, Miss Silvertown III, landed on the new Winter Tire during the icy months last winter. Note the tracks made when the steel coils dug into the ice.



3. One of the first synthetic airplane tires for airline service coming out of the curing mold. C.A.A. approved, these tires are now being used on a few planes by leading airlines.

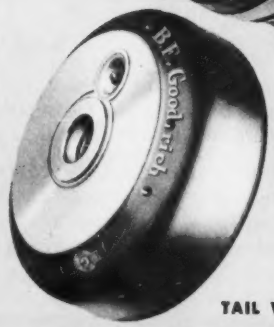
WINTER SILVERTOWN



ALL-SYNTHETIC SILVERTOWN

CHANNEL TIRE

SMOOTH CONTOUR SILVERTOWN



TAIL WHEEL TIRE (VENTED)

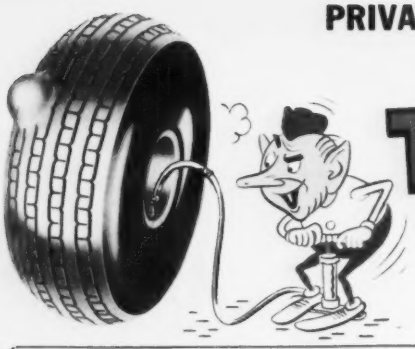
NEW CATALOG SECTION: A new catalog section, giving the complete line-up of B. F. Goodrich tires, including data on sizes, capacities, weights, contact areas and other information, is just off the press. Write for your copy today. B. F. Goodrich. Aeronautical Division, Akron, Ohio.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

PRIVATE GEORGIE GREMLIN WENT HAYWIRE ON THIS



TIRE SERVICE QUIZ

CAN YOU SCORE 100%?

(Pick correct answer from a, b, and c)

1 **The aircraft tire shown in cross-section is . . .**

a. Streamline type.
b. Low pressure type.
c. Smooth contour type.

2 **This one is . . .**

a. Streamline type.
b. High pressure type.
c. Smooth contour type.

3 **All tires and tubes should be properly balanced because . . .**

a. Improper balance spoils the airfoil.
b. Improper balance causes vibrations; uneven tread wear.
c. Improper balance endangers the plane's flight stability.

4 **Proper balance is achieved by . . .**

a. Weighing tire and tube carefully before installation.
b. Placing balance mark on tube next to red dot on tire.
c. Consulting regulation balance charts.

5 **Boots or casing patches should be used only for emergency repairs because . . .**

a. They're apt to block the valve core.
b. They cause serious tube checking or cracking.
c. They cause unbalance, uneven tread wear, and may cause an injury beyond repair.

6 **After a tire is mounted it should be inflated, deflated, then reinflated because this process . . .**

a. Permits the tube to assume its proper contour within the casing and gets rid of wrinkles.
b. Seats the flange.
c. Loosens the valve core.

7 **The Drop Center Rim has a well or depression because . . .**

a. It makes the rim stronger.
b. It permits mounting and dismounting.
c. The increased air chamber increases carrying capacity.

8 **A valve fishing tool is used to . . .**

a. Clean out valve stems.
b. Locate lost valves at night.
c. Keep valves from slipping through valve hole during mounting.

9 **Locking rings should be properly seated before air pressure is applied because . . .**

a. Poorly adjusted ring can fly off and kill somebody.
b. Poorly adjusted ring cuts into tire.
c. Poorly adjusted ring gives false pressure reading.

10 **Approximately how many B. F. Goodrich Aviation Products are being used by our armed forces?**

a. 80. b. 47. c. 25.

WHAT IS YOUR SCORE?

Each correct answer counts 10. 1-b, 2-c, 3-b, 4-b, 5-c, 6-a, 7-b, 8-c, 9-a, 10-a.

This is one of a series of maintenance quizzes prepared for ground crew trainees of the U. S. Army Air Forces Technical Training Command. It is our hope that this series will help all maintenance men get maximum service, safety, and efficiency from military, commercial, and civilian aviation equipment.

B. F. GOODRICH AERONAUTICAL DIVISION, AKRON, O.

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

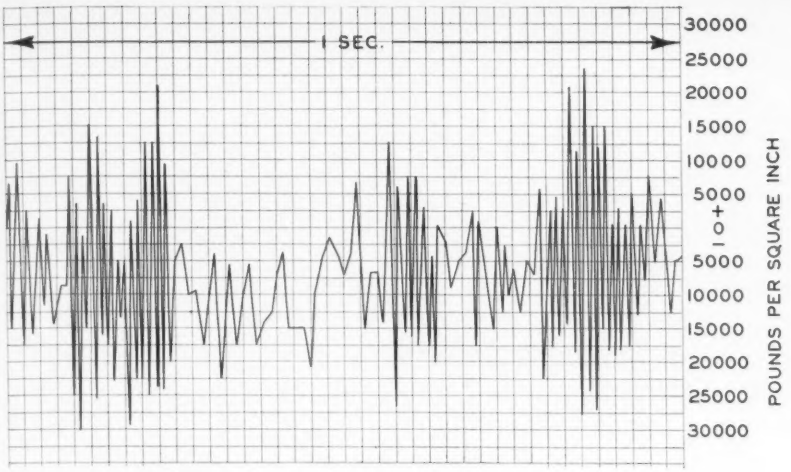


FIG. 13. Radio recorder chart strain gauge pickup—buffeting condition.

INTERVALOMETER

An intervalometer is used in connection with the recorders whenever it is desirable to record instrument readings at definite time intervals. In climb studies one set of readings could be made every 30 sec. or any other desired time element. The intervalometer is controlled by cams and selector switches and is constructed to start and stop the recorders and to withhold the signal until proper recording speed is reached. It is also equipped with an override button to permit continuous recording whenever desired.

FLEXIBILITY

The recorder is extremely flexible in its operation. All leads from the pickups are brought in to a terminal board at the scanning switch where any desired continuity can be set up. An example of this is in dive and pull-out studies where acceleration plus the added effects of air bumps is the important factor. The scanning can be set up to read acceleration 50 times in a second in addition to 50 other pickups in the same second. Or the pilot may be provided with a selector switch with which he can select any pickup at will and obtain a continuous record of that pickup. Such tests have been made at Vultee to record loads on a structural member that had been failing in flight. The plotted curve of the loads on this member during buffeting encountered in a pull-out is shown in Fig. 13. The average load of approximately 7,000 lbs. per sq.in. had been anticipated, but the load reversals of a magnitude of over 20,000 lbs. per sq.in. in tension and 30,000 lbs. per sq.in. in compression at a rate of 6,000 cycles per min. were entirely unexpected. Previously it had been impossible in the laboratory to reproduce failures in this member, but by applying load reversals as revealed by the flight recorder, laboratory reproductions of flight failures were accomplished.

The equipment described in this paper should be considered as an experimental or prototype system. In production models many improvements in size, efficiency, and accuracy are anticipated. Standard commercial electronic parts are used throughout the entire system. A standard E. M. Berndt Corporation Auricon 16-mm. sound on film recorder is used. The paper chart recorders used are a Brush crystal oscillograph Model OBA and an Esterline Angus 0–5 M.A. Graphic Recorder equipped with a quick trip, high-speed overdrive chart motor.

OPERATIONS

Actual flight operations of the equipment have been limited and have been confined in general to tests of the system itself. In flight tests made under U.S. Army supervision, instrument readings from the radio recorder conformed with those observed in the airplane.

All parts of the system carried in the airplane have been built to avoid errors due to vibration and acceleration. The equipment with pickups installed in an airplane undergoing daily flights over a period of a month has performed without any failure or need for servicing.

The recorder materially reduces the number of hours of test flying necessary to obtain flight performance data on new type airplanes and engines. The automatic analyzer saves engineering time in plotting charts of all flight data.

In addition, the system provides a means for obtaining simultaneous flight data that previously have been unobtainable because of the rapidly changing conditions encountered in flight testing. It is realized that all the possible applications have not been explored but additional types are being investigated as time permits. Types of units currently in use and the types currently under development are shown in Table 1.

TABLE 1

Present Pickups	Proposed Pickups
Strain gauges	Thermocouples
Altimeter	Angle of pitch
Air speed	Angle of attack
Manifold pressure	Angle of yaw
Tachometers	Angle of airflow
Fuel flow	Ground speed-wheels
Acceleration	Hydraulic pressures
Liquid pressures	Hydraulic valve positions
Liquid temperatures	Vibration
Air or gas temperatures	
Air or gas pressures	
Pressure differentials	
Suction	
Exhaust gas temperature	
Control surface positions	
Control cable or rod loads	
Positions — flaps, throttle, etc.	

Although the Radio Recorder necessarily consists of a multiplicity of parts and might therefore give the impression of intricacy, in reality it is simply the combination of units well known to those conversant with the art. As previously stated, it rapidly transmits and records data that heretofore were virtually impossible to obtain; it eliminates inaccuracies due to the human element in observing and recording needed data; and it eliminates inaccuracies due to variables with respect to time. The system puts its records in such forms that the engineer may accurately interpret them. The disc records, which may contain as many as 260,000 amplitudes on one disc, afford a compact and permanent form for filing.

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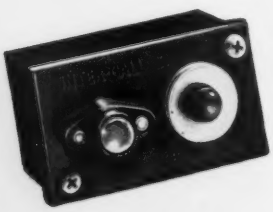


An intercommunication call light system which is installed on Multiplace observation and level and dive bomber airplanes, where interchangeability of crew is impossible. Wt. 5 oz. Overall length 3", width 1⅝", depth 2¾"

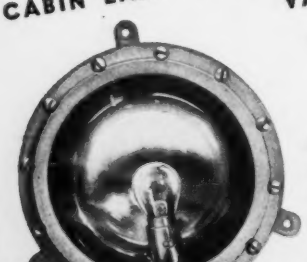
COCKPIT LAMP ASSEMBLY TYPE C-4

A.A.F. Specification 94-32294-A
Standard Aircraft No. SA-1007-D

A sturdily constructed metal lamp, used as an auxiliary light source on all types of aircraft. Can be furnished with or without red filter. Wt. 11 oz. Overall length 5 1/16", diameter 1¾".

CABIN LAMP ASSEMBLY TYPE A-7 VAPOR-PROOF

A.A.F. Specification 94-32157A
Standard Aircraft No. SA-2672-B



A cabin dome light which, due to its special type of construction, is moisture proof. Wt. 1½ lbs. Overall length 6⅞", diameter 5⅞".

CABIN LAMP ASSEMBLY TYPE A-5

A.A.F. Specification 94-32115
Standard Aircraft No. SA-1271-C

A radio shielded cabin dome light suitable where a single contact lamp, flush mounting, is desired. Lens—clear, frosted ⅛" thick heat treated glass. Wt. 10 oz. Overall length 6¼" approx., diameter 5½", depth 2".

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Engineering of Power Control and Altitude Selection in Air-Line Operation

R. DIXON SPEAS*
American Airlines, Inc.

Operation Procedure

THE OVERALL EFFICIENCIES of air-line operation are mainly established by the selection, maintenance, and operation of flight equipment. The engineering ability of the air lines has been more concentrated on the selection and maintenance of flight equipment than on operation procedures. The importance of efficient flight procedures, however, becomes more and more apparent in the operation of large airplanes. Recently a proposal was made that all operators of the most widely used transport reduce their operating power from 600 to 500 hp. It was argued that considerable gasoline would be saved and only a few minutes would be added to the air-line schedules. An engineering analysis of the situation, however, indicated that although considerable gasoline could be saved in this manner, the domestic fleet of 150 of the subject transport would have to be increased by 13, while flight crews and mechanical forces would have to be increased by approximately 10 per cent. The overall economic effect of such a change was found to be a considerable increase in direct and indirect flying costs. The proposed change in operation procedures was then rejected because of the overall economic effect, as well as the fact that the shortage of airplanes (including tires) and trained personnel was greater than the shortage of gasoline.

Presented at the Air Transport Session, Eleventh Annual Meeting, I.A.S., New York, January 25–29, 1943.

* Assistant to Vice-President—Engineering.

The studies of operation procedure in this instance proved their importance in providing a specific detailed analysis of the overall effects of a proposed change in operation policy. The value of such studies in the original establishment of air-line operation procedures is even more important.

Operation procedure studies will be considered under the two headings of "Power Control" and "Altitude Selection."

Power Control

Power control, as has been said, is an extremely important factor in the operation of all large airplanes. Changes in cruising power for any airplane are reflected in changes in speed, rate of fuel consumption, total fuel consumed, and pay load for any flight. The many possible combinations of these variable factors have led to the establishment of several systems of power control.

Maximum Endurance Operations

The lowest power at which the airplane will satisfactorily operate is known as maximum endurance operation. Practically, this operation is used only in emergencies. An increase in power above the maximum endurance condition for any flight will both decrease the time of flight and increase the pay-load weight (by decreasing the total fuel consumed). The low-speed operation of maximum endurance is then seen to be undesirable for any flight operation except where it is desired to stay in the air for the longest possible period of time without regard to distance traveled.

Maximum Range Operation

When the power is increased beyond the lowest powers, a point is reached where further increase in power for any flight will decrease the weight available for pay load (by increasing the total fuel consumed). Operation exactly at this transition point is known as maximum range operation and provides the minimum fuel consumed per mile traveled. Two variables determine the power for maximum range operation, namely, airplane weight and wind condition. Without further discussing the basic factors that determine maximum range, it can be seen that this operation will allow an airplane to carry the maximum cargo load for any one flight, as well as operate for the longest possible distance on a specified gas load or with a specified pay load at a specified gross weight. Maximum range operation has been extensively used on trans-oceanic flights.

Pay-Load Miles per Dollar

In commercial air-line operations an important basis of power control is maximum pay-load miles per dollar. This operation condition is specified by a balance between the speed, pay load, and cost factors. As power is increased (beyond the point of maximum range) the speed increases while the pay load decreases, and costs per pay-load ton-mile decrease to a point and then increase. The maximum pay-load miles per dollar operation is at the minimum point of pay-load ton-mile costs. The operation conditions of maximum pay-load miles per dollar vary according to flight distance as well as airplane and engine design. The procedure for determining the operating conditions for maximum pay-load miles per dollar is divided into economic and weight analyses. In order to discuss the basic factors entering into the analyses, an example is presented on a typical air-line transport for a 300-mile flight.

Fuel Costs

The first factor of the economic analysis to be considered is fuel costs, shown in Table 1. It can be seen that the operating fuel cost per mile increases with power between 500 and 750 hp. The related increases in specific fuel consumption, as well as the power-speed ratio cubic relation, cause this increase.

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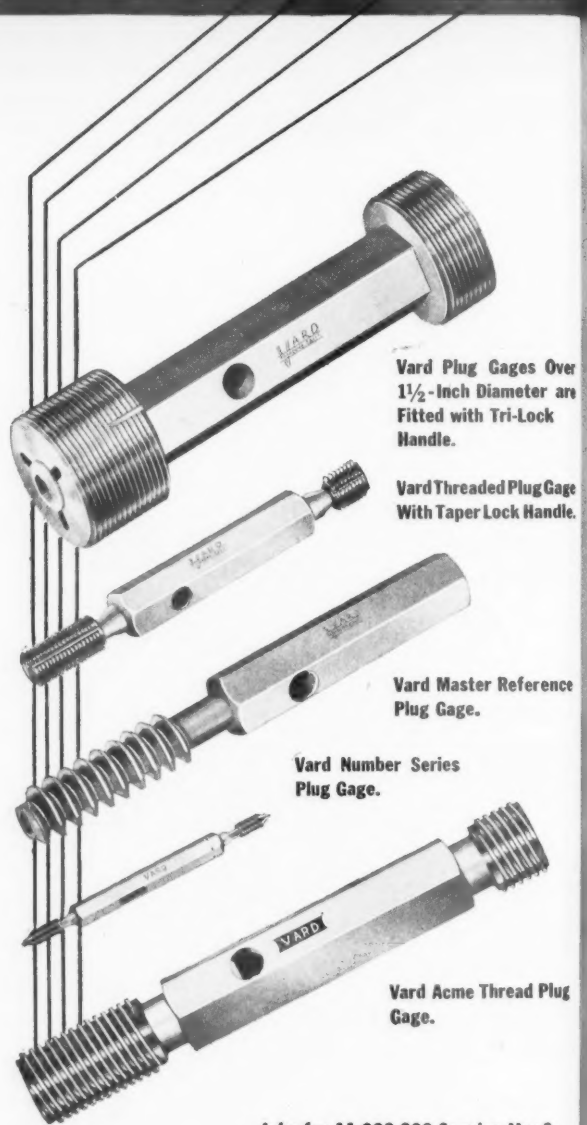

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TABLE 1

Variation of Fuel Costs with Power (Representative Air-Line Transport)

Power, Hp.	S.F.C.	Gal. per Hour	Miles per Hour	Miles per Gal.	Cost per Mile, Cents
700	0.514	120.0	195.5	1.63	8.28
650	0.476	103.2	189.5	1.84	7.34
600	0.460	92.0	182.7	1.99	6.78
550	0.460	84.4	175.5	2.08	6.49
500	0.460	76.8	167.2	2.18	6.20

Flight Crew Costs

The factor of flight crew costs (Table 2) is somewhat difficult to evaluate because of the complexities involved in present wage rates and possible future variations. The general assumption is made that the flight crew will be paid on an hourly rate and their cost per mile will therefore vary inversely with the speed. The faster the airplane is operated, the lower will be the operating cost per mile.

TABLE 2

Variation of Flight Crew Costs with Power (Representative Air-Line Transport—Captain, First Officer, and Stewardess)

Power, Hp.	Speed Change from 600 Hp., Per Cent	Cost per Mile, Cents
700	+7.00	8.49
650	+3.72	8.79
600	0	9.13*
550	−3.94	9.49
500	−8.49	9.91

* Present operations.

Depreciation Costs

Airplanes, engines, and radio equipment have all tended to become obsolete rather than worn out, while propellers have tended to wear out rather than become obsolete (see Table 3). Airplanes, engines, and radio equipment are therefore depreciated on a time basis and propellers on a mileage basis. The mileage basis for the propellers is further supported by the fact that propeller wear is almost directly related to the number of take-offs and landings made.

TABLE 3

Variation of Depreciation Costs with Power (Representative Air-Line Transport)

Power, Hp.	Speed Change from 600 Hp., Per Cent	Airplane, Engine and Radio Equipment Depreciation, Cents per Mile	Propeller Depreciation, Cents per Mile	Total Depreciation, Cents per Mile
700	+7.00	4.62	0.58	5.20
650	+3.72	4.78	0.58	5.36
600	0	4.97*	0.58*	5.55*
550	−3.94	5.17	0.58	5.75
500	−8.49	5.39	0.58	5.97

* Present operations.

Passenger Expenses

As shown in Table 4, the longer the passenger is in the air, the more he will eat, read, and wear out. The passenger expenses are then considered to be on an hourly cost basis.

Insurance

Insurance costs, as given in Table 5, are considered to be on a time basis. This assumption then considers that the same safety factor exists for all engine operation powers.

Maintenance and Overhaul

The assumption is made in Table 6 that the maintenance and overhaul costs for aircraft and radio vary directly as to hours of service. The factor of engine maintenance and overhaul costs at various horsepowers is an extremely elusive value (see Table 7). The general assumption in the example analysis is that the engine maintenance and overhaul costs will be constant on a mileage basis for various operating powers, thereby giving an inverse ratio between this cost and the operating speed.

Oil cost, loss and damage, and miscellaneous flying expenses are considered constant on a mileage basis regardless of horsepower. This cost for the subject airplane is 0.54 cent per mile.

Direct Flying Costs

Considering the respective totals of all costs, a comparison is obtained between total direct flying costs for the different operating powers as shown in Table 8. These total costs can be presented in graphic form (Fig. 1) and, if the airplane operation restriction is space rather than weight, the airplane operator would choose 650 hp. as his operating power for maximum pay-load miles per dollar.

For clarification it might be said that space restriction operation occurs when the airplane with fuel can be filled with

TABLE 4

Variation of Passenger Supplies and Expenses with Power (Representative Air-Line Transport)

Power, Hp.	Speed Change from 600 Hp., Per Cent	Passenger and Supply Cost, Cent per Mile
700	+7.00	2.09
650	+3.72	2.17
600	0	2.25*
550	−3.94	2.34
500	−8.49	2.44

* Present operations.

TABLE 5

Variation of Insurance Costs with Power (Representative Air-Line Transport)

Power, Hp.	Speed Change from 600 Hp., Per Cent	Insurance, Cost, Cent per Mile
700	+7.00	0.85
650	+3.72	0.88
600	0	0.91*
550	−3.94	0.95
500	−8.49	0.99

* Present operations.

TABLE 6

Variation of Maintenance and Overhaul for Aircraft and Radio Costs with Power (Representative Air-Line Transport)

Power, Hp.	Speed Change from 600 Hp., Per Cent	Cost per Mile, Cents
700	+7.00	3.67
650	+3.72	3.80
600	0	3.95*
550	−3.94	4.11
500	−8.49	4.29

* Present operations.

TABLE 7

Variation of Engine Maintenance and Overhaul Costs (Representative Air-Line Transport)

Power, Hp.	Speed Change from 600 Hp., Per Cent	Cost per Mile, Cents	Cost per Hour, Dollars
700	+7.00	3.78	6.42
650	+3.72	3.78	6.22
600	0	3.78	6.00*
550	−3.94	3.78	5.76
500	−8.49	3.78	5.49

* Present operations.

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TABLE 8

Summary of Direct Flying Costs

	Cruising Horsepower				
	700	650	600	550	500
(A) Crew expenses, cents per mile	8.49	8.79	9.13	9.49	9.91
(B) Fuel, cents per mile	8.28	7.34	6.78	6.49	6.20
(C) Depreciation, cents per mile	5.20	5.36	5.55	5.75	5.97
(D) Passenger supplies and expenses, cents per mile	2.09	2.17	2.25	2.34	2.44
(E) Insurance, cents per mile	0.85	0.88	0.91	0.95	0.99
(F) Aircraft and radio maintenance and overhaul, cents per mile	3.67	3.80	3.95	4.11	4.29
(G) Engine maintenance and overhaul, cents per mile	3.78	3.78	3.78	3.78	3.78
(H) Miscellaneous, cents per mile	0.54	0.54	0.54	0.54	0.54
TOTAL, cents per mile	32.90	32.66	32.89	33.45	34.12

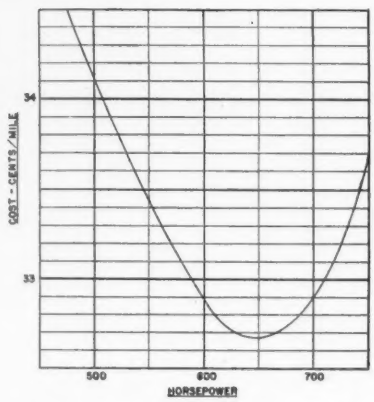


FIG. 1. Direct flying cost vs. cruising horsepower.

pay load before it reaches the allowable airplane gross weight. Conversely, weight restriction operation occurs when the airplane cannot be filled with pay load without exceeding the allowable airplane gross weight. In general, short-range passenger operation is usually on a space restriction basis, while long-range passenger operation and both short- and long-range cargo operation is usually on a weight restriction basis.

If the airplane operation restriction is weight rather than space, a weight analysis must be made before the operating condition for maximum pay-load miles per dollar can be determined.

FUEL LOAD REQUIRED

A primary factor in the weight analysis is determination of fuel loads required for the various cruising powers (Table 9). These fuel loads will vary according to cruising power to be used. In the weight analysis it is assumed that a constant fuel reserve is required regardless of cruising power and the respective fuel loads are then fuel to be consumed plus fuel reserve. The corresponding pay loads can then be calculated according to airplane empty operating weight and gross weight, and the cost per ton-mile of pay load directly follows by dividing the cost per mile by the pay load in tons.

The final ton-mile operating costs for the operation with a weight restriction can then be seen to favor operation at 600 hp. for maximum pay-load miles per dollar.

ACTUAL APPLICATION

A considerable number of individual operating problems must be met in the practical application of a maximum pay-load miles per dollar analysis. Engine operation limitations, traffic demands, and competitive conditions must all be considered in specifying operation procedures. Such consideration may determine the desirability of operation at other than maximum pay-load miles per dollar. It can be generally said, however, that all air-line operations should be analyzed on a maximum pay-load miles per dollar basis and then modified as necessary according to the aforementioned local conditions.

PAY-LOAD MILES PER HOUR

Closely related to the maximum pay-load miles per dollar operation is maximum pay-load miles per hour operation. Emergency and military air-line operation often make it essential that the cargo and personnel be transported between two points in the shortest possible time. Maximum pay-load miles per hour has been developed to accomplish this function and can be best visualized as that operation which, over any period of time, will allow the maximum amount of cargo to be moved between any two points with a given number of airplanes and flight crews. In other words, getting there "fustest with the mostest." Although the maximum pay-load miles per hour operation gives maximum utility of both airplanes and flight crews, the fuel consumption per ton of cargo transported may be considerably increased.

Using the basic data from analyses for maximum pay-load miles per dollar, we arrive at 700 hp. as the specified cruising power for maximum pay-load miles per hour. This is shown in Table 10. Assuming a constant number of hours operation per day, it can be seen that the carrying capacity of the flight equipment is considerably greater at 700 hp. than at the lower powers. The fuel consumed per ton-mile cargo, however, is usually comparatively high with maximum pay-load miles per hour. Therefore, whenever the existing bottleneck in military or emergency operations is in fuel rather than airplanes or flight personnel, the operation of maximum pay-load miles per gallon of fuel (identical to the previously discussed maximum range) is preferable. Other conditions of operation limitations such as engine operation limitations, traffic demand, and operation conditions may also modify the operation to other than maximum pay-load miles per hour. The basic analysis, however, should first be made and then modified as necessary.

TABLE 9

Variation of Pay-Load and Ton-Mile Operating Costs with Power

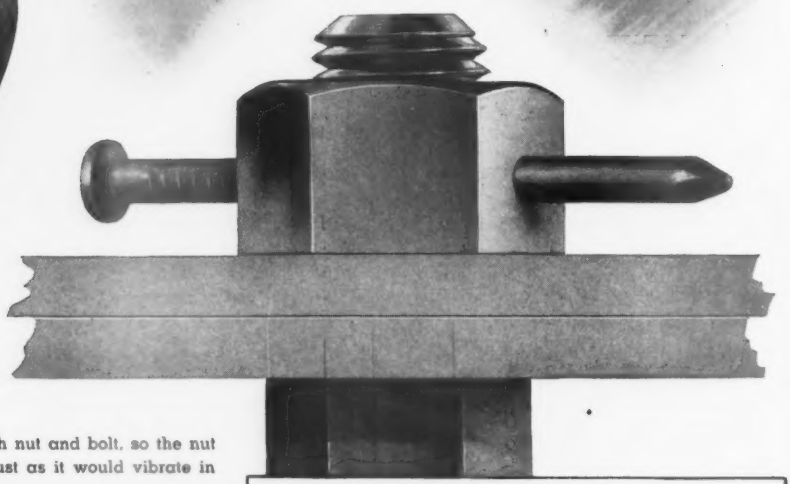
Cruising Power	Fuel Consumed in Take-off and Climb	Cruise Miles per Gal.	Fuel Consumed in Cruise*	Fuel Reserve	Total Fuel Load	Pay Load†	Direct Flying Cost	Cost per Pay-Load Ton-Mile, Cents
700	40	1.63	169	200	409	5,746	32.90	11.45
650	40	1.84	150	200	390	5,860	32.66	11.15
600	40	1.99	138	200	378	5,932	32.89	11.10
550	40	2.08	132	200	372	5,968	33.45	11.20
500	40	2.18	126	200	366	6,004	34.12	11.35

* 275 miles.

† Weight available for pay load and fuel = 8,200 lbs.

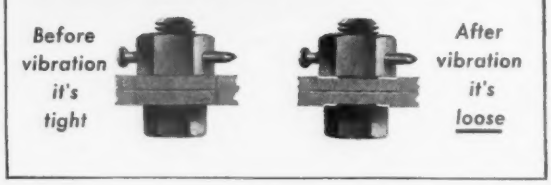
LET'S SPIKE A NUT

. . . to prove a point!



DRIVE A SPIKE right through both nut and bolt, so the nut can't budge. Now vibrate the assembly just as it would vibrate in ordinary use.

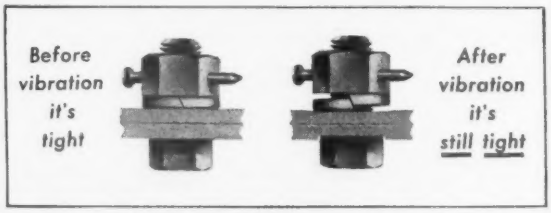
HERE'S WHAT YOU GET



—the nut did not move, but the strain and vibration of metal on metal wore the other parts loose—dangerously loose. Wear by abrasion, and *bolt stretch* etc. *loosen every vibrating part.*

Now keep the spike in but add a strong Kantlink spring washer,—then vibrate it just as you did in the first test!

HERE'S WHAT YOU GET NOW



Yes, still tight, because the strong Kantlink spring reaction held it tight. The Kantlink Spring washer expanded exactly as fast (and as far) as the inevitable *wear tended* to loosen the parts.

There is no substitute as economical. No fixed nut nor any short range multi-toothed washer can possibly equal the great holding power of a *wide-range live spring*—a big helical spring such as Kantlink.

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KANTLINK TRADE MARK

the long-range Spring Washer

TABLE 10

Variation of Pay-Load Miles per Hour with Power (300-Mile Flight)

Cruising Power	Block to Block Speed	Pay Load	Pay-Load Miles per Hour	Decrease in Pay-Load Miles per Hour Compared to 700 Hp., Per Cent
700	172.5	5,746	991,000	0
650	168.5	5,860	987,000	0.4
600	163.0	5,932	967,000	2.5
550	158.0	5,968	943,000	4.8
500	151.5	6,004	910,000	8.2

ALTITUDE SELECTION

Altitude selection is an important operation refinement as applied to domestic operation.

The efficient long-range flights of today are preceded by long and careful analysis of wind and atmospheric conditions at all possible cruising altitudes. Such an analysis allows a judicious choice of altitude for the most efficient operation. A considerable amount of time is, of course, required for this analysis of all cruising altitudes, and on domestic operations where the fuel-saving requirements are less exacting the analyses are not so extensive. The discussion here will be directed primarily at domestic operations where the usual domestic procedure is for the pilot to confer with the meteorologist concerning wind and atmospheric conditions along the route to be flown. After obtaining a general picture of conditions to be expected, the pilot will decide that a certain altitude "looks good" and will thereby make his choice of cruising altitude. After choosing his altitude, he then must make all necessary calculations for his flight plan. These calculations concern rates of climb, air speeds, and fuel consumptions with corrections according to wind, temperature, and altitude conditions.

Each pilot works out his own flight plan, and on some domestic routes as many as 40 duplicating flight plans have been individually calculated in a twelve-hour period to cover a 200-mile airway. All flight plans are made on a basis of general information as to winds to be expected with 20 min. to an hour expended in calculating each of the duplicating flight plans.

Fig. 2 shows an instrument designed to both calculate and present all information necessary for judiciously planning an air-line flight. The pilot can study the results after the calculator has been set up with current atmospheric conditions and thereby make decisions as to altitude selection, time over intermediate points, and total time required for flight.

Flight Plan Analysis

In making the necessary calculations for the flight plan analysis, several factors must be considered. The climbing and cruising horsepowers to be used in flight may be variable or they may be fixed, according to schedule requirements. The "Flight Plan Analyzer-Altitude Selector," as shown in Fig. 2, assumes constant horsepowers and air speeds to be used in climbing—a standard air-line procedure. The analyzer gives the following information to be used for altitude selection and the filling out of flight plans:

(1) Total time and fuel consumed for each cruising altitude.

(2) Time required for each leg of the flight at each cruising altitude.

(3) Magnetic headings for each leg of the flight at each altitude.

A modification of the boards will allow them to be presented on a constant-speed basis. With such an arrangement, the answers will be given in

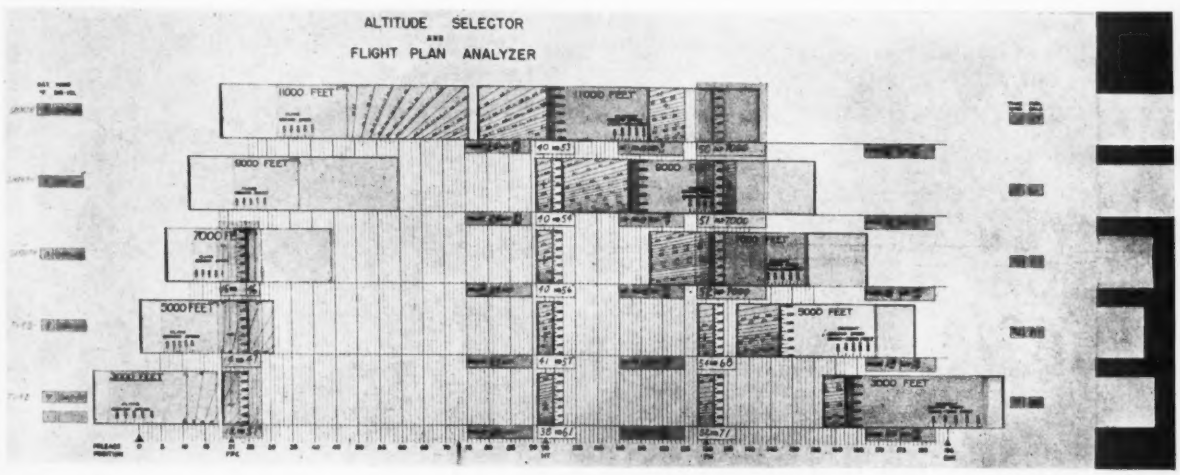
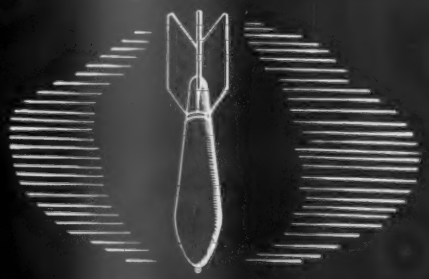


FIG. 2.

TABLE 11

Flight Analysis Recapitulation Sheet (New York to Boston)

Alt.	A.T.	Wind	True Climb Air Speed	Ground Course	Climb Ground Speed	Mag. Heading	True Descend Air Speed	Ground Course	Descend Ground Speed	Mag. Heading	True Cruise Air Speed	Ground Course	Cruise Ground Speed	Mag. Heading
3,000	7	340-30	125	44	109	30	188	71	186	61	173	61	165	51
5,000	5	350-40	129	44	101	29	193	71	181	58	176	71	162	57
7,000	0	340-45	133	61	118	41	196	81	199	67	179	71	174	56
9,000	0	330-50	138	61	129	39	201	81	213	67	183	71	185	54
11,000	−5	320-60	143	61	141	36	205	81	229	66	187	71	200	53



Who Wins Wars?

Strangely enough, the average man does! Much as we all detest war the fact is that under its stimulation a nation always develops new products with infinite peacetime applications. To date, scores of fantastic devices have been created for war purposes which one day will contribute mightily to the American Way of Life. Weatherhead is producing at the rate of *millions every day* many products that have peacetime application. Just as we've helped build cars, planes and refrigerators in the past, Weatherhead is well prepared to help you build these new products of tomorrow.

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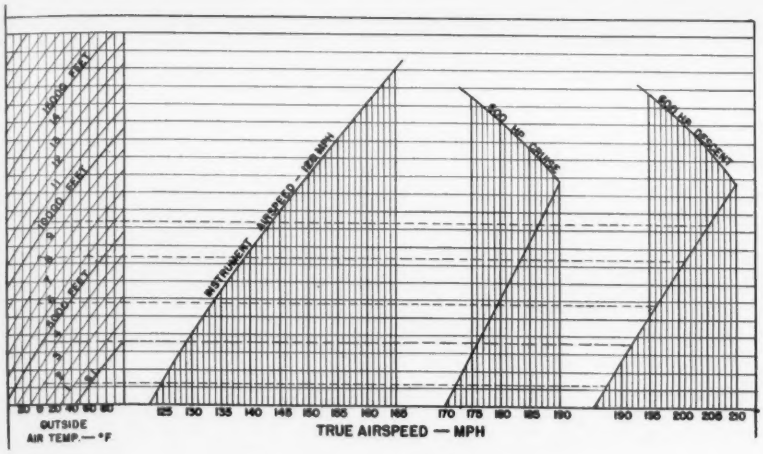


FIG. 3. Air-speed calculator chart.

required horsepowers at each altitude as necessary to maintain the schedule speed. It can be expected, however, that the charts will usually be constructed on a constant horsepower condition for domestic operations. If for any reason it is considered necessary to adjust the resulting flight plan by a change in horsepower used, the altitude selection can still be made without chart change, since the chart is concerned directly with speeds. The charts should, of course, be made on a variable power basis if the horsepower change is anticipated to be of frequent occurrence.

Basic Calculations

The basic calculations necessary in setting up either the analyzer or board are accomplished in the following steps: The respective temperature, wind, and ground-course information for all cruising altitudes is first inserted on the flight analysis recapitulation sheet (Table 11). The true air speeds are then determined by means of the air-speed calculator chart (Fig. 3). The chart as shown is for a constant 600-hp. operation. Additional power conditions, however, can of course be included on this chart as desired. This type of chart has been used by various aircraft manufacturers and air lines for some time.

The true air speeds are next tabulated on the flight analysis recapitulation sheet (Table 11). From the respective winds, courses, and true air speeds, it is then possible to determine the ground speeds and magnetic headings. The ground-speed calculator, Fig. 4, is designed to obtain ground speeds and magnetic headings by simple solution of the wind air-speed triangle. The example shown on the instrument is for an airplane flying a magnetic course of 40° at an air speed of 180 m.p.h. with a wind of 130°, 50 m.p.h. The resulting ground speed is then seen to be 172 miles per hour with a correction angle of +16° (heading therefore 56°).

With all air speeds and magnetic headings determined, it is then possible to directly adjust the flight plan analyzer-altitude selector to give all desired information. The analyzer is adjusted by means of the individual altitude slides. Three flights over the New York–Boston airway gave a "score" for the analyzer as shown in Table 12.

It can be seen that the accuracy of the analyzer compares favorably with the regular pilot flight plan.

The selection of 5,000 ft. in direct conflict with recommendations of the analyzer "cost" the pilot of flight 54 3 min. over 7,000 ft. estimate and 6 min. over the 9,000 ft. estimate. With two-engine flight costs of approximately $1.00 a minute, it can be seen that on a busy airway with 30–40 round-trip flights per day the economic value and timesavings of exact flight analysis becomes relatively important. An average saving of 2 min. per flight would mean a total saving of $40,000 to $60,000 per year.

An additional advantage of the analyzer is the allowance for accumulation of flight data so that all flights may benefit by the experience of previous flights. Flight data can be posted on the analyzer as reported by flight crews. These data will give an accurate check on winds and temperatures at various altitudes so that the analyzer can be corrected and kept accurate throughout the day and/or night.

(*Continued on page 101*)

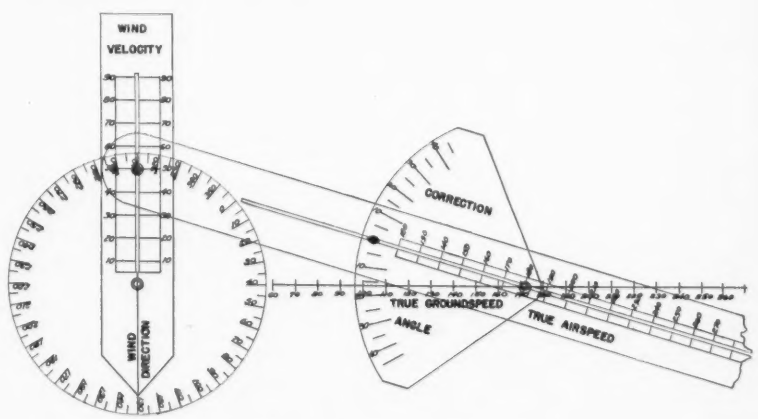


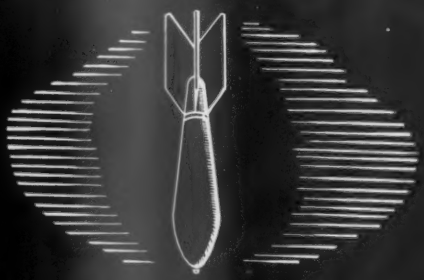
FIG. 4. Ground-speed calculator.

TABLE 12

Practical Test of "Flight Plan Analyzer-Altitude Selector"

Flight Cruising Altitude	Flight No. 14, 7,000			Flight No. 17, 7,000			Flight No. 54, 5,000		
	Analyzer estimate	Pilot's estimate	Actual	Analyzer estimate	Pilot's estimate	Actual	Analyzer estimate	Pilot's estimate	Actual
Time over Portchester	11	12	11	11	9	10	11	10	10
Time over Hartford	38	38	38	38	34	37	39	40	39
Time over Putnam	50	50	50	50	45	48	52	53	52
Time over Boston	69	70	73	69	64	69	72	74	75

NOTE: All times given are in *minutes*.



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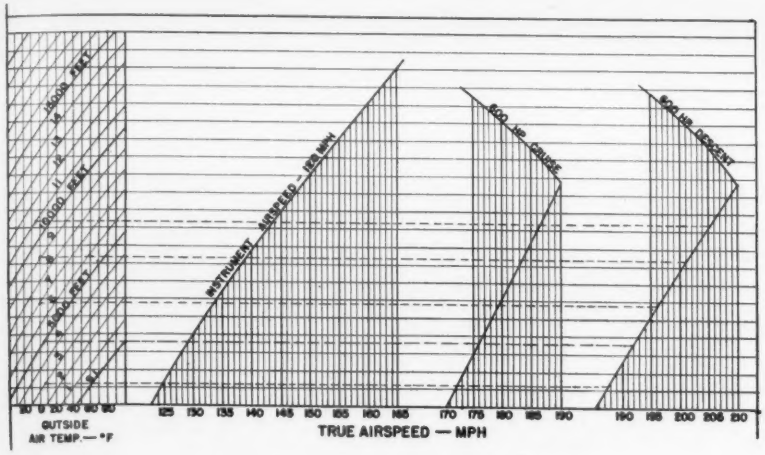

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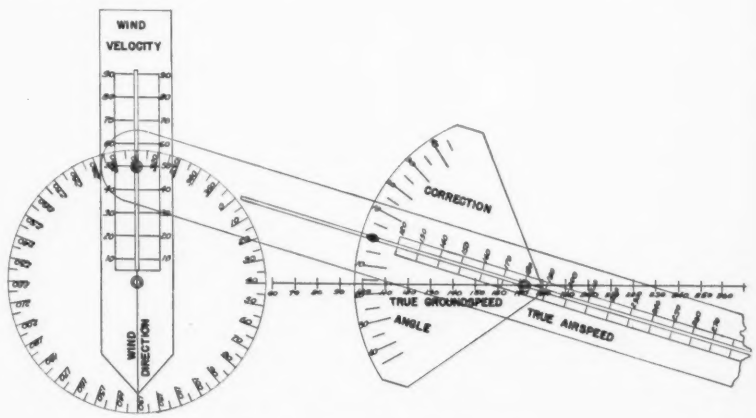

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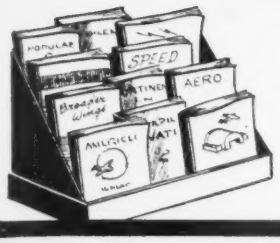
NOTE: All times given are in *minutes*.

Propellers
OVER THE MEDITERRANEAN
The blue Mediterranean, key to the military situation in southern Europe and gateway to the East, is rapidly coming under Allied domination, thanks in large part to superior air power. In these operations Liberators and Flying Fortresses are at the spearhead of the attack—all equipped with Hamilton Standard Hydromatic propellers.
HAMILTON STANDARD PROPELLERS
East Hartford, Connecticut
ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION



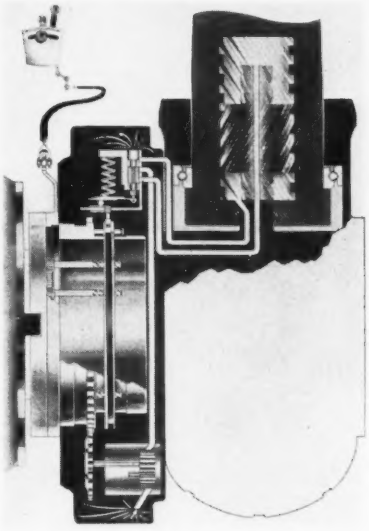
Periodicals

Accessories

Combat Comfort. Albert A. Arnhym. Equipment developed to increase the comfort of the crew of military aircraft is described. The writer explains how the provision of comfortization equipment increases the military efficiency of the airplane even though some increase in weight is entailed. The task of obtaining a satisfactory compromise between comfortization on the one hand and considerations of weight, space, electric-current consumption, and service or supply problems on the other is discussed. *Air Progress*, June, 1943, pages 36, 37, 67, 68, 4 illus.

How Heaters Are Made for American's Flagships. The construction of flash-tube boilers for American Airlines' planes is traced from the first step in the procedure to the completion of the unit. The description includes details on some original methods and tools for bending and welding steel tubing. When completed, each boiler consists of three different sized loops of tubing of three rows each, extending in opposite directions, making a total of 18 pieces of tube whose ends are arc welded into two drilled header plates. Photographs illustrate the various tools used in the manufacturing process. *Aviation*, May, 1943, pages 236, 237, 394, 9 illus.

Rubber's Part in Making Regular Air Mail Possible. Willson Hunter. The development of deicing equipment for aircraft as carried out by The B. F. Goodrich Company is traced. The writer describes how Dr. W. C. Geer, former vice-president in charge of research of this company, conceived the idea of mounting a rubber "overshoe" on leading edges of aircraft and then inflating and deflating this rubber sheath to break off the ice. A small model was tested and proved successful. The device in its present form is described. *National Aeronautics*, May, 1943, pages 21, 47, 2 illus.



Operational diagram of the automatic, controllable-pitch General Motors Aeroprop, showing the regulator, hub, and control arm (*left*), with the pump (*bottom*) to the governor (*top center*) which controls hydraulic flow to and from the torque unit (*right*) in the root of the blade.

Aerodynamics

Aerodynamic Performance of the Towed Glider. Alexander Klemin and Walter C. Walling. The towed glider or the aerial train as it is sometimes called has been employed successfully for war purposes under special conditions. Such successful military use and the increase in pay load which follows when a powered airplane is used to tow a string of gliders have led to optimistic evaluation of the glider train both for military and commercial purposes. The purpose of this paper is to investigate the performance of the towed glider to see whether these expectations are likely to be realized.

In Part I of this paper certain aerodynamic theorems have been set down which serve as a useful introduction to the subject. Part I concludes by the discussion of some indications regarding towed glider design and performance which are apparent from the theorems themselves.

In Part II calculations have been carried out of the performance of a conventional transport airplane to which one, two, three, or four gliders are attached.

Part III is a discussion of the calculated results, with some consideration of how the powered airplane might be modified to make it more useful in a glider train. *Journal of the Aeronautical Sciences*, June, 1943, pages 185–196, 14 illus.

Streamlining Dynamic Stability Computations. Part I. Max M. Munk. A series of four articles on the

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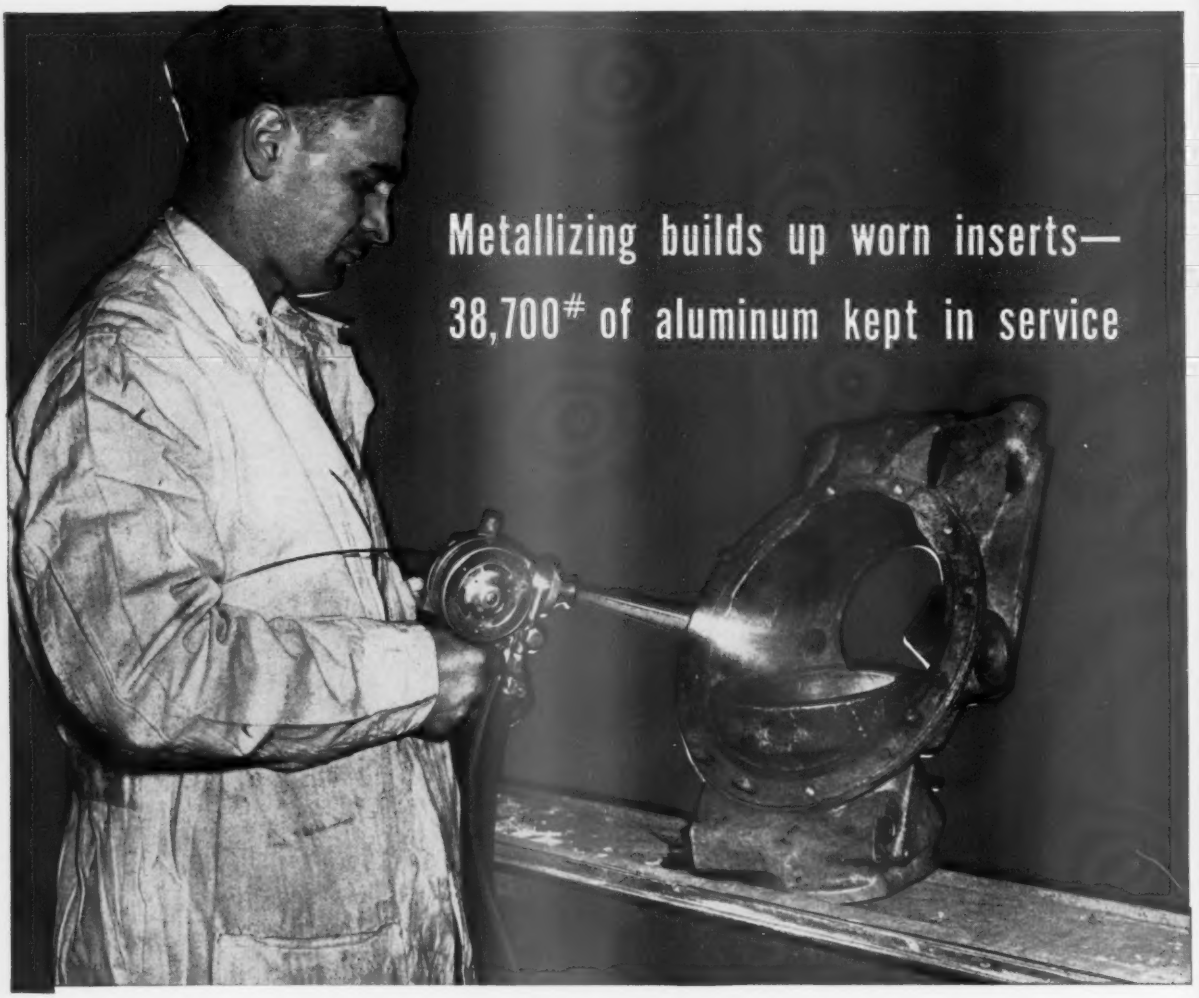


Nine hundred of these 43-pound aluminum housings were salvaged in a year's time by building up their worn, iron inserts by metallizing. The large amount of precision machining that would be required for finishing new castings was avoided. The old bearings were re-used, and the reworked assemblies gave more service than originally.

Thus the war effort is being aided by conservation of materials and labor, and the continuation in service of hard-to-get equipment.

The iron insert in this housing is subjected to severe thrust from the gears, so it must be anchored solidly. This is taken care of by casting it integrally with the aluminum housing. Building up a worn insert by metallizing does not disturb this security, nor does the work reduce the high strength of the aluminum. The added metal is bored out and the original bearing put back in place, ready for additional months of service.

Perhaps there's a cue here on means of maintaining *your* hard-working aluminum alloy equipment. Had the aluminum part of this assembly been worn, it, too, could have been salvaged by metallizing with aluminum. Alcoa engineers will gladly advise you on methods of doing this. ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh, Pennsylvania.

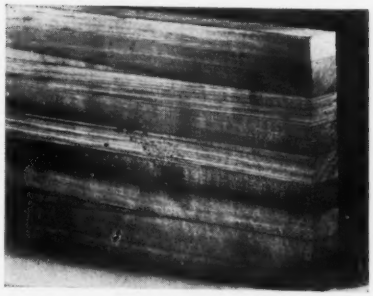
ALCOA ALUMINUM

computation of dynamic stability begins with the statement that these computations require more accurate data about the aerodynamic properties of projected airplanes than can be obtained but that less precise results are also valuable, particularly when some unconventional feature of the design is studied. The difficulties in the performance of these computations are briefly reviewed, and, while certain complexities are conceded, it is held that the troubles encountered do not seem to be too great to be overcome. The several difficulties are discussed, one by one, with a view toward their possible elimination.

The first article deals with positive and negative signs. It is hoped that the new method will be considered an improvement over the old system and will provide engineers with a better tool for performing their work. The dynamic system of reference is defined and the wind-tunnel system is explained. The use of the two systems is compared and the proper procedure is outlined. The observance of the rules stated and the understanding of the relation of the direction of the positive wind-tunnel forces to the directions of the positive wind-tunnel moments will remove the difficulties encountered in the determination of the correct signs. Suggestions are made in connection with future wind-tunnel reports. *Aero Digest*, May, 1943, pages 205, 206, 288, 1 illus.

Power Requirements. Roy E. Marquardt and Robert De Vault. The first of a series of articles on the calculation of the effect of air forces upon the performance of an airplane states that every such calculation fundamentally consists of an estimation of the net thrust horsepower available from an engine-propeller combination under given operating conditions. The next step is an estimation of the relative percentages of this power required to overcome the drag and increase the speed or altitude of the airplane.

Methods are developed for the estimation of excess thrust horsepower, maximum and minimum speeds for level flight, absolute ceiling, service ceiling, and critical altitude, all of which are defined. Formulas are reviewed for the calculation of the power required and the drag coefficients, with specific data on fuselage and nacelles, wings, tails, and miscellaneous components such as radio masts, landing-gear doors, etc. Numerous shortcuts are demonstrated for these calculations and ways for simplifying the mathematics are explained. Examples of the use of the writers' methods of drag approximation are given.



In this view of Taylorcraft "multilaminar" wing spars, the 6 by 6 in. block has been "sliced" to the required thickness for one spar. While 13 laminations can be counted in the side of the spar, which resulted from the welding of scarfed pieces, the butt end of the spar reveals only nine laminations. Note the manner in which cross-grained and end-grained woods, some of which could not be used as one-piece spars, are utilized in the middle sections. (*See* page 143.)

Among the subjects for future articles in the series are the relationship between net available thrust horsepower and forward air speed at a given altitude and manifold pressure, analysis of flight-test data, and gliding ratio. *Western Flying*, May, 1943, pages 60, 62, 64, 74, 76, 83, 12 illus.

Air Cargo

In Wartime, What About Imports by Air? Lt. (j.g.) Langdon P. Marvin, Jr. The writer discusses the priority system for imports by Army, Navy, and commercial planes and how the system operates. The services rendered by the Air Transport Command and the National Air Transport Service are reviewed, and some figures are given on the comparative volume of air cargo and other means of transportation, although wartime regulations compel the omission of important data. Results are summarized under headings of volume, speed, and safety. *Air Transportation*, May, 1943, pages 18–20, 1 illus.

When Air Cargo's Ship Comes In It Could Be Lighter-Than-Air. P. W. Litchfield. The Chairman of the Board of The Goodyear Tire & Rubber Company reviews early activities in lighter-than-air cargo transportation, giving the achievements of the German dirigibles Graf Zeppelin and Hindenburg, the American naval airships Akron and Macon, as well as other airships that were used for long-distance air transportation. The present and future prospects of lighter-than-air craft are discussed with reference to the convertibility of this type from war to peace uses and vice versa.

The practical aspects of commercial operations with airships are discussed briefly and the author outlines an airship that would be somewhat larger than the *Akron* or *Macon* type, perhaps of 10,000,000 cu.ft. capacity, carrying from 50 to 100 passengers and from 5 to 10 tons of mail and express, over distances of 3,000 to 5,000 miles at a cruising speed of 75 m.p.h. It is emphasized that America has a great advantage in the exclusive possession of supplies of helium gas. A folding map is incorporated in the article, showing possible lighter-than-air transport routes, with distances and time of transit between important points. *Air Transportation*, May, 1943, pages 29–36, 4 illus.

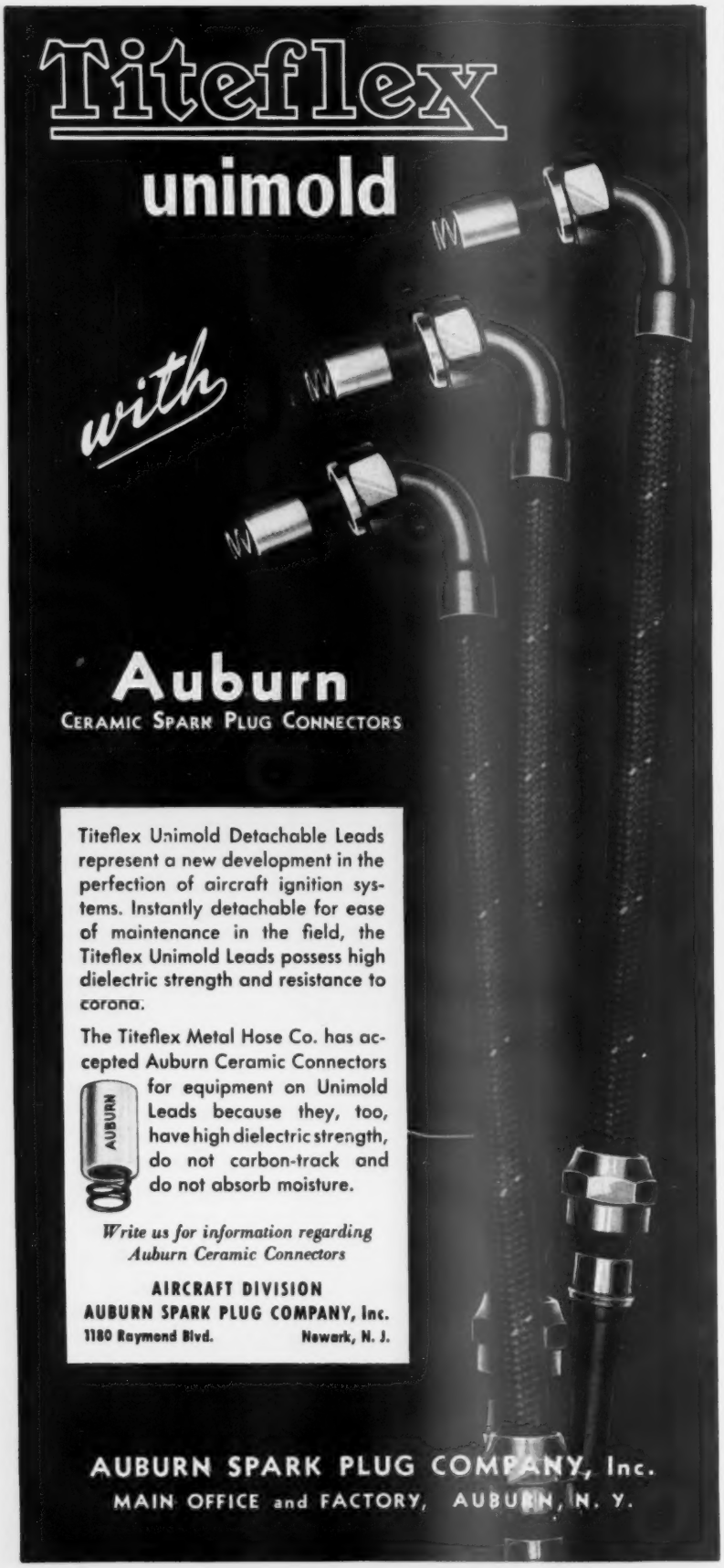
Air Power

Post-Tunisian Air Strategy. John A. Ward. The writer speculates upon how the United Nations might proceed with the seizure of Italy, depicts the consequences of Italy's surrender upon both German and Allied war strategy, and denotes the part air power will play in the campaign. It is shown that among the advantages to the United Nations of having Italy eliminated from the war are: the Mediterranean will be made secure, Italy will become an Allied air and sea base of great importance, and she will also be a leading source of war supplies. The strategic areas of Europe which, with Italy as an air base, will become air targets for the United Nations are pointed out.

Air operations that will make possible the seizure of Sicily—first step in the suggested strategy—are described. From there, the writer traces the projected progress of the United Nations along the shores of the peninsula. He also lists some factors that are likely to facilitate the Italian defeat. *Aero Digest*, May, 1943, pages 116–118, 349, 350, 7 illus.

The Invasion Has Started! William Levenor. An interpretation of the European aerial bombardment as the preparatory softening process for an invasion of the continent. Noting the growing air power of the Allied nations, the writer also explains the pattern of the aerial bombardment, based upon coordinated effort between R.A.F. night bombing and A.A.F. day bombing.

Criticisms of daylight, precision bombing are refuted. The criticisms are summed up under three generalizations: (1) In daylight operations, losses from enemy fighter attacks become prohibitively high beyond the range of fighter escorts; (2) on long flights into the interior of Germany, the bomb loads of the Liberator and Fortress are too small to justify the operations; (3) precision, high-altitude bombing is practicable only in


Titeflex
unimold
with
Auburn
CERAMIC SPARK PLUG CONNECTORS
Titeflex Unimold Detachable Leads represent a new development in the perfection of aircraft ignition systems. Instantly detachable for ease of maintenance in the field, the Titeflex Unimold Leads possess high dielectric strength and resistance to corona.
The Titeflex Metal Hose Co. has accepted Auburn Ceramic Connectors for equipment on Unimold Leads because they, too, have high dielectric strength, do not carbon-track and do not absorb moisture.
AUBURN
Write us for information regarding Auburn Ceramic Connectors
AIRCRAFT DIVISION
AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark, N. J.
AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE and FACTORY, AUBURN, N. Y.

fine weather, which most of the time does not exist over western Europe.

In tracing the trend toward increasingly heavy raids, the writer estimates what production, equipment, personnel, and preparation would be required for raids by 1,000 R.A.F. planes nightly in addition to A.A.F. participation. *Flying*, June, 1943, pages 21–23, 158, 160, 5 illus.

El Arma Aerea De Turquia (The Turkish Air Force). It is stated that military aviation may play an important part in the defense of Turkey because of the country's geographic position. The development of the air arm did not progress so fast as had been planned by the Turkish authorities because the extensive efforts to normalize the nation economically and socially had consumed a large part of its material resources. Aeronautical facilities include the Turk Hava Kuruma, an aeronautical association that is maintained by popular support and by government subsidies. In many schools throughout the country there are free theoretic courses in gliding, parachuting, and navigation. The alumni begin training as parachutists and soon afterward are transferred to actual flying courses.

The Turkish air force is divided into brigades and, as in many other European countries, is under the command of the regular armed forces. The service is compulsory, but many of the specialists are volunteers. The training of the officers is based on that of the R.A.F. It is stated that the equipment of the Turkish air force is composed of a great variety of types, including Buecker training planes and Heinkel bombers from Germany, Polish and French military planes, British Blenheims and United States fighter planes and that this mixture of foreign equipment imposes a grave handicap. The writer states that at the outbreak of the present war the Turkish air force had about 600 airplanes, but it may be assumed that this figure has been increased by the addition of more modern machines. *Revista De Aeronautica*, January, 1943, pages 28, 29.

The Test of War. Expansion of the Royal Air Force from June, 1937, to the present war status is reviewed. Figures on the strength of British air power in 1937 and in 1942 show the relative numbers of the various types of combat airplanes, comparing them with the strength of the German forces. Stages in the growth of the R.A.F. and its achievements are traced, and the necessity for specialization in aircraft types is pointed out. The three major divisions of the R.A.F., the Fighter Command, the Bomber Command, and the Coastal

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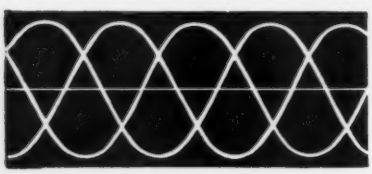

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Westinghouse is solving these problems with special three-phase, 400-cycle *alternating-current* systems for aircraft.

A three-phase a-c installation in the huge B-19 was so successful that larger a-c systems are now being perfected. This increased power enables planes to fly higher, farther, and shoot faster.

Into this change-over, Westinghouse is pouring the "know-how" of its early pioneering work in changing industrial power systems from d-c to a-c.

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Command are surveyed, with reference to the part each is playing in the war. *The Aeroplane*, April 2, 1943, pages 392, 393, 4 illus.

Is America Vulnerable to Aerial Bombing? C. K. Apjohn-Carter. The writer's belief is that America is vulnerable to aerial bombing and he gives his reasons why. Although his discussion considers the possibility of attack from Japan, he believes that attacks from that quarter can only be minor and readily-defended. Regarding Germany, his point of view is different. His positive assertions that the Germans will bomb America are supported by explanations of how they will do it, why they must do it now when they have not attempted it before, and why bombing raids from Germany can be successful, rather than just "token" raids. Among the objections he refutes are those based on the argument that the bombers will suffer from fuel shortage or mechanical failure.

The writer also demonstrates why cities in the middle and western parts of the United States are as vulnerable to attack from Germany as those in the eastern part. With occupied Norway as a starting point, he traces a route over the "top of the world" whereby German bombing expeditions could reach Detroit or Seattle almost as easily and quickly as they could reach New York. *Air-Age*, August, 1943, pages 6–9, 56, 6 illus.

German View of Japanese Air Power. Walter Zuarl. This is a reprint of an article on Japan's air power taken from the German journal *Der Flieger* and made available for publication by the British Ministry of Aircraft Production. It is explained that Japan's air service is divided into army and navy air forces. The development and the reorganization of the army air force is reviewed and the function of the air staff is described. The advancement in industry is also outlined. Information on Japan's naval air service is given. The various types of Japanese warplanes are listed. *Aircraft*, April, 1943, pages 10–13, 8 illus.

The Promise of Air Power. Part III. Tom Ashley. The conclusion of a series of articles on the basic principles of American air power is devoted mostly to a discussion of the leadership of the generals of the United States Air Forces. The writer states that although Allied strategy has not availed itself of the full use of aviation's might the qualities of such men as Chennault, Kenney, and Andrews will yet influence an overall strategy leading to global victory. He states that air power is still only an auxiliary to ground and naval forces and has not yet been fully employed for its destined purpose—the acquisition of air superiority over enemy countries and the destruction from the air of enemy war resources. The accomplishments of the late General Andrews in laying the groundwork for global air power when he commanded the GHQ Air Force are commended. The achievements of General Arnold and General Doolittle are also reviewed. *Southern Flight*, pages 12, 13, 16, 2 illus.

Air Transport

Natal Base. Henry W. Bagley. An account of the activities and importance of Parnamarim Field, Natal, Brazil. A midpoint in the United States' chain of air bases, Natal is a vital center from which American bombing and transport planes proceed to Allied fighting fronts in Africa and Asia. Operation of United States' planes at this base come under the jurisdiction of the South Atlantic Wing of the Army Air Transport Command, and the article tells how this was a development of a ferrying system originally called Pan American Air Ferries. *Flying*, June, 1943, pages 86, 167, 2 illus.

The Civil Strato-Plane. D. C. Greenwood. Because of the advantages gained when flying at altitudes over 10,000 ft., it is believed that a large proportion of future passenger aircraft employed on arterial routes will be fitted with pressure cabins. The design of pressure cabins, the progress made in their development, and how the use of pressure cabins may influence the general design of airplanes are discussed. Various problems connected with stratosphere flying are also considered. *Aeronautics*, June, 1943, pages 33–35, 4 illus.

International Air Transport. The writer explains his belief that postwar air transport should be treated as one phase of the general problem of international transportation and not as a separate issue. He shows why coordination with existing surface transportation methods is important to the future of air commerce. Based on the premise that per-ton-per-mile transportation costs will never be so low by air as by land or water, he contends that surface transportation will have the advantage over air transport at a time when economy will be a major consideration. His arguments are qualified by their application more particularly to Europe, where industrial centers are within overnight distance of each other via surface transportation, than to areas where delivery by air can save weeks of time. *Flight*, April 29, 1943, pages 449, 450; "Post-War Horizons," Martin Marvin, *Air Progress*, June, 1943, pages 46, 47, 68, 1 illus.

Las Acciones de la Aviación a gran distancia (Operation of Long Distance Aviation). Carlos M. R. de Valcárcel. A scientific study of air transport consisting of three fundamental parts. After giving the classical definition of range, the mathematical theory is presented, bearing upon maximum practical flight distances and duration of flight under varying conditions, based on a chronologic review of the achievements of aeronautics in this particular field. The second part of the article is devoted to a concise investigation of long-range civil aircraft as well as military airplanes and the third deals with the operation and servicing of these airplanes. *Revista De Aeronautica*, January, 1943, pages 5–8, 7 illus.

Feeder Airlines Pose Problems. A discussion of four major problems that face the aircraft industry and the C.A.B. with regard to the postwar development of feeder air-line operations: (1) To define a feeder air line; (2) to decide on what type of operations, pickup or standard, should be encouraged and under what circumstances; (3) to decide who should be permitted to engage in feeder air-line operation; (4) to set a standard procedure for feeder air-line hearings so as to avoid duplication of proof of convenience and necessity whenever possible.

After a consideration of the factors involved, the writer concludes that as an answer to the first problem a feeder air line is (1) a common carrier, (2) which performs the dual function of concentrating and dispersing mail, passengers, and property, (3) within a given marketing area, (4) from widely scattered points, (5) to a few terminal points. For the second problem he suggests that two types of feeder air-line services may be provided to meet the special problems imposed by the different conditions existing among a large number of communities: (1) pickup and delivery—to serve primarily towns too small to warrant the construction of an airport; (2) standard operations—to provide complete transportation for air-mail passengers and cargo at towns large enough and with a sufficient volume of business activity to support an adequate airport and facilities.

Plastic Cockpit Ventilator, Made of Lumarith, Reduces Weight in Republic's P-47 Fighter Plane

Lumarith saves weight!*

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REPUBLIC'S THUNDERBOLT has already written some amazing air history in the matter of performance. But that is but a curtain-raiser to the history which it will write in combat. Naturally, any manufacturer has a right to feel proud of contributing a part or a product for this great plane, but this is not a message of pride. It is a reminder of what Lumarith plastics can do in cutting down weight and raising altitude ceilings. The ventilator tube of Lumarith molded plastics is a sample of this important type of contribution.

Lumarith plastics have the military stamina and versatility to meet the exacting requirements of the aircraft industry. The services of our engineers and technical service departments are on call for assistance in solving problems in plastics. Celanese Celluloid Corporation, *The first name in plastics*, 180 Madison Ave., New York City, a division of Celanese Corporation of America Sole Producer of Lumarith* and Celluloid* plastics . . .

Representatives: *Cleveland, Dayton, Philadelphia, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.*

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The writer also advocates a revision of the C.A.B.'s past "overcautious" attitude with reference to grants for new routes, as well as applications by companies new to the air-line field. He indicts that such an attitude interferes with the progress of the air transport program. *Aviation*, May, 1943, pages 227, 229, 378, 381, 382, 385, 386, 2 illus.

Cross Atlantic in 6 Hours! A report of several speed records set by Ferry Command planes flying from Canada to Britain and from Britain to Canada. From Newfoundland to Britain the record of 7 hours, 16 min. was achieved by Capt. G. R. Buxton. The best actual trans-Atlantic crossing from East to West—because of the prevailing headwinds encountered—was made by Capt. Richard Allen in 10 hours, 18 min. *Canadian Aviation*, May, 1943, page 88, 2 illus.

We. . .the People. . .Fly! William A. Hunter. This extensive article on Trans-Canada Air Lines chronicles the main incidents in the history of the air line, surveys its current operations, and indicates its future potentialities. The writer outlines its present routes and activities. Figures are given on the amount of air mail, air express, number of passengers, and revenue miles flown by Trans-Canada in 1938, 1939, 1940, 1941, and 1942. A statement of the aircraft with which the company was equipped as of December 31, 1942, is included.

Points of organization, direction, operating procedures, servicing, and maintenance are taken up by the article. Personnel, officers, directors, and equipment are described. *Commercial Aviation*, April, 1943, pages 48–50, 53–56, 58, 62, 64, 66, 68, 102, 46 illus.

ATC: Army Airline. John G. Norris. The outstanding work the Air Transport Command is performing in the various war theaters is described. It is explained that the system has a threefold function: (1) ferrying new combat planes to the war's many fighting fronts; (2) transportation of supplies and key personnel to the active war theater; and (3) bringing back vital raw materials not produced in the United States, such as quinine, tin, mica, platinum, tungsten, chrome, and balsa wood. The writer tells how the work of the Air Transport Command has increased in importance with the increase in cargo plane production. The various types of cargo planes used are described, and examples of the kind of jobs being performed by the Command are outlined. *Air Progress*, June, 1943, pages 10–13, 62, 8 illus.

The Cessna Aircraft Company's Loadmaster undergoing factory flight tests at Wichita, Kan. Designed to operate from small fields, the new plane will be able to dispatch supplies and men to actual battle areas, its designers say, saving much of the tedious truck transport now necessary from large airports at major supply bases to front-line positions.

Aircraft Spotting

Aircraft Recognition Hints. Sq. Ldr. S. W. Gardner. Procedures are recommended for learning how to identify aircraft. To reduce the number of airplanes that the neophyte must learn to recognize (it is stated that 400 different types are currently used by the Allied and Axis air forces) these methods of initial elimination are suggested: first, that he concentrate on learning to identify enemy planes and, second, that he begin with the particular types of planes likely to be encountered in his specific area. When those classifications are firmly fixed in the student's mind, it is pointed out, he can gradually enlarge his sphere of recognition—from enemy planes found in a given area to all enemy planes, and from enemy planes to friendly planes.

The writer designates recognition of the plane's general appearance as the first exercise to be mastered and intensive study of photographs and silhouettes as a means of acquiring the ability to spontaneously identifying aircraft. When this is mastered, he advises that familiarization with the distinctive features of each airplane is the next step to be followed. *Flying*, June, 1943, pages 60, 169, 170, 1 illus.

Airplane Descriptions

Design Analysis of the Bell Airacobra from Cannon to Tail. E. Eugene Miller. This is an examination of the principal design and engineering details of the P-39. The plane's design characteristics and structural arrangements are studied part by part and at some length, and major sections are described with reference to materials, gauges, and reasons for their selection. It is claimed that certain technical details of the Airacobra have been undisclosed until revealed by this article. Various tables present such fundamental information as dimensions, balance factors, and component weights.

With the subject matter arranged for engineering reference, the first component examined is the fuselage. Subheadings under this are the aft fuselage and the cowling. The next major heading is the wing center section, under which comes the subheading of the trailing edge section. The study of the outer wing panels includes sections on the wing skin, wing tips, ailerons, trim and servo Tabs, and wing flaps. Under the empennage the article covers separately the elevators, vertical stabilizer, and rudder. The instrument panel, pilot seat, turnover bulkhead, and aft cabin are considered in the portion of the article devoted to the pilot cabin. The description of the landing gear includes data on the shock struts, wheels and brakes, retracting mechanism, and landing gear fairings. The section on engine and accessories is broken down into details about the fuel system, fuel tanks, fuel controls, oil system, engine oil tank, oil cooling system, oil dilution system, surge valve, and reduction gear box oil tank. It also includes the subheadings of the cooling system, electrical system, engine starting system, generator and booster coil, landing light, heating and ventilating system, vacuum system, and deicing equipment. Under surface control system information on the elevator and aileron con-

Jap-hunting without a gun!

THE TRUE STORY OF HOW A CRIPPLED LOCKHEED LIGHTNING OUTFLEW 13 JAP ZEROS AND GOT HOME, SAFE!

1. With cameras instead of guns in its nose, a P-38 Lightning was photographing the Jap

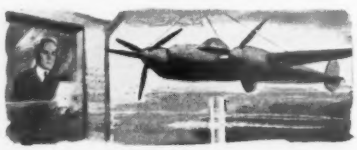
base of Rabaul. Suddenly ten Zeros dove out of the sun, and before the American pilot knew what was happening, tracer bullets were ripping into his plane and then one engine conked out on him.

2. Somehow, with only one engine left, he had to get away from those ten Zeros. He pulled back the stick, jammed down the throttle, pointed her nose at the sky. By the time the Japs came to, he was five miles up and on his way home.

3. 400 miles later, three more Japs started a deadly game of hide and seek. Still going on one engine, he streaked straight out over the ocean and "Just ran 'em out of gas!" Yes, he

ran them out of gas . . . but he also ran clear back to New Guinea with photographs that were vital to our Coral Sea victory.

4. The Lightning is used as a camera plane because it can fly faster, higher, and farther than any enemy fighter—can take punishment and still deliver the goods. These qualities result from many months of designing and testing. From hundreds of wind tunnel experiments we developed the non-stall wing design that makes it impossible for a P-38 to go into a tail-spin even on one engine. It's this sort of careful designing and testing that give every Lockheed and Vega plane *extra* strength and *extra* dependability.



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LOOK TO *Lockheed* FOR LEADERSHIP

trols, flap control, and trim-tab controls is indexed. The last two sections are devoted to the armament and armor of the airacobra. *Aviation*, May, 1943, pages 126–155, 65 illus.

R.A.F. Aircraft 1918–1943. A review is made of British aircraft from the inception of the Royal Air Force in April, 1918. Brief descriptions are given of outstanding British types through the 25-year period. Tracing the evolution of major design and construction features, the article shows the development of current fighters, bombers, reconnaissance planes, torpedo planes, troop carriers, and flying boats. *Flight*, April 1, 1943, pages 329–336, 342, 40 illus.

A Co-operative Challenger. A description of a British racing plane design that was sponsored by D. Napier & Son Limited, the Heston Aircraft Company, and Lord Nuffeld. The salient features of the plane are given in detail and specifications are listed. Conceived for the purpose of bettering the world's landplane speed record, this British racing aircraft was estimated to achieve a speed of 480 m.p.h. One prototype was completed and tested. It was of wooden construction and, with the exception of the cooling system, its design fundamentally followed orthodox lines. *Flight*, April 15, 1943, pages 387–391, 14 illus. "The Napier-Heston Racer," *The Aeroplane*, April 16, 1943, pages 447–449, 2 illus.

Latest Nazi Warplanes. This is a compendium of photographs of German combat aircraft. The illustrations are accompanied by brief descriptions of each plane. Despite the title, some older types which are still active are included. The following planes are shown: Junkers Ju 88A6; Messerschmitt Me 323, Me 109F, Me 110, and Me 210; Bucker Bu 133C; and Heinkel, He 111K, He 60, He 114, He 115K2, and He 177. There are also descriptions of the Dornier Do 17, Do 215, Do 217E, Do 26; Junkers Ju 87 and Ju 52/3mK; Blohm & Voss BV 141 and 222; Henschel Hs 126; and Focke Wulf FW 187, FW 189, FW 190, and FW 200 K. *Skyways*, June, 1943, pages 35–47, 39 illus.

The Typhoon. Five photographs accompany some brief design and performance details on Britain's latest single-engined fighter—the Hawker Typhoon. Although actual performance figures cannot be given, the Typhoon's speed is assumed to exceed 400 m.p.h. It is powered by a 24-cylinder sleeve-valve, liquid-cooled Napier Sabre engine of H formation in the 2,000-hp. class. In general design it follows orthodox Hawker practice but differs considerably from the Hurricane structurally. The most notable difference is the Typhoon's stressed-skin form of fuselage in place of the girder-type fuselage of the Hurricane. One model of the Typhoon carries twelve 0.303 machine guns in the wings, while another has four 20-mm. Hispano cannons. *Flight*, April 29, 1943, pages 440, 441, 5 illus.; *The Aeroplane Spotter*, May 6, 1943, page 102, 5 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Specifications of the Basic 64. This tabulation gives the name, span, length, loaded weight, and maximum speed of the 64 basic models of British, American, and German first line airplanes, advanced trainers, and gliders. The information in connection with the Third Class Proficiency Test of the National Association of Spotters' Clubs is also given. *The Aeroplane Spotter*, May 6, 1943, page 100.

The Harassing Hurricane. A review of the Hawker Hurricane's performance in the Middle East theater of war. The activities of the Hurricane in Greece, Crete, Abyssinia, Somaliland, and Eritrea covered service as fighters, bombers, Army co-operation planes, and as close army support aircraft. Photographs show a number of the Hurricane's many types, including the prototype of 1935 and the latest 40-mm. cannon-armed, tank-attack 11D model, which played a large part in the 8th Army's African victories. *Flight*, April 29, 1943, pages 442–444, 8 illus.

Airports

An International Airport Plan. A diagrammatic plan is offered as a proposed standard for an International Airport. Intended for both landplanes and seaplanes, this airport is designed to conform with twelve practical considerations that are listed in the article. It provides for long take-off runs within as compact an area of land as possible, functional grouping of buildings and maintenance sheds, one-way taxi-track systems, and elimination of interference with the main operational business of the runway by rail and road communications servicing the airport. The advantages of this plan are outlined and factors governing the choice of locations are given. *The Aeroplane*, April 30, 1943, pages 506, 507, 2 illus.; "Airport," Antonin Raymond, Michael Czaja, Vincent Furno, Sydney Katz, Richard Stein, and Earl Strunk, *The Architectural Forum*, May, 1943, pages 123–128, 15 illus.; "Space Saving Airports for Tomorrow's Skyways," *Popular Science*, July, 1943, pages 96, 97, 3 illus.; "Airport Planning for the Future," *Western Flying*, May, 1943, pages 47, 73, 2 illus.

Armament

Disposition of Fighter Armament. D. I. Husk. Disadvantages of the wing-installation of fighter aircraft guns are discussed. When the fixed, forward-firing guns of a fighter aircraft are installed in such a position that the recoil forces have an effective moment about the center of gravity, then the aircraft will develop a pitching motion as a direct result of the discharge of the guns. The projectiles in any given burst will then be dispersed across, instead of concentrated on, the target.

A theoretic expression for this dispersion of projectiles is developed, and hypothetic data, corresponding approximately to a modern, single-engined, single-seater fighter, are used to derive typical values of the dispersion at two ranges. These values are then considered in conjunction with the two main forms of attack, and it is deduced that the discharge of more than two rounds per gun is valueless since the dispersion of projectiles then exceeds the radius of the target.

The conclusion is that, by mounting the armament in a battery in the nose, lengthy bursts of accurate, concentrated fire at long range are possible. The use of telescopic sights is envisaged if the potentialities of such an increase in the operational efficiency of fighter aircraft are to be fully exploited. *Aircraft Engineering*, April, 1943, pages 94–97, 3 illus.

Enemy Aeroplane Weapons 1939–1943. The cannons and machine guns with which Axis aircraft are equipped are reviewed. It is stated that the standard weapons of the Luftwaffe at the beginning of the Battle of Britain were the M.G. 15, the M.G. 17 and the 20 mm. (Oerlikon) M.G.F.F. The origin, construction, and characteristic features of these guns are given. The statement is made that these guns are now being replaced, since some of them have been found to have limitations.

A new type, known as M.G. 151, is in two forms, one firing a 15-mm. shell and the other a 20-mm. shell. This Mauser design is compared with the

70 hour sentence in the world's hottest jail!...

We are America's largest builder of prison equipment.

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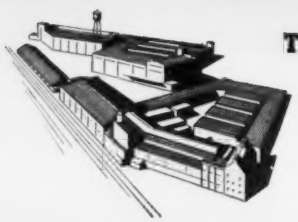

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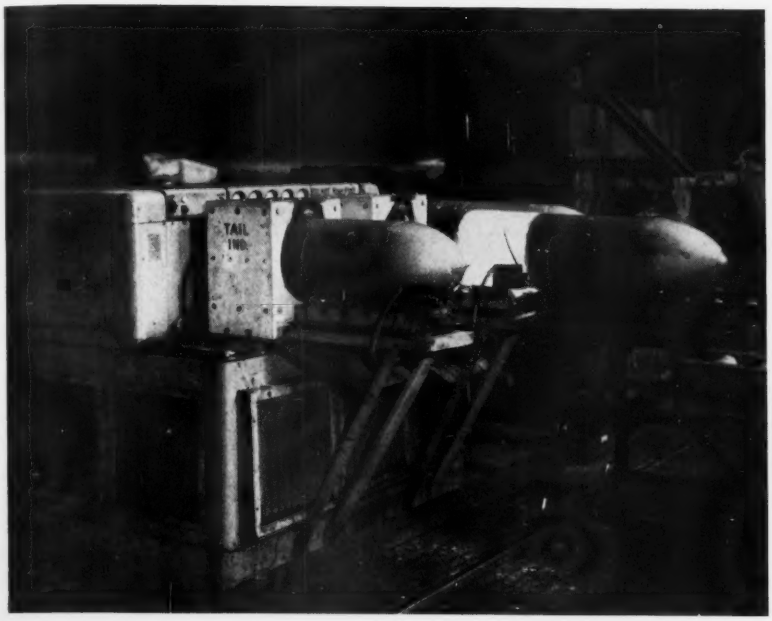

Five hundred-pound bomb casings being "Tocco" heated prior to tail spinning. Operator has just removed a casing from the inductor. Note the absence of tongs, though heated end is up to 2,000°. This is the first phase of the second operation in the shaping of bomb cases at Wheeling Steel. The last phase is shaping the tail area into a truncated cone. On this induction machine it takes only 3 min. and 15 sec. to heat the tail end of the pipe. A second bomb is heating while in the background can be seen a third case ready at the end of the gravity conveyer. Tocco units are products of The Ohio Crankshaft Company.

older Oerlikon. The M.G. 15 is also being superseded by a newer form called the M.G. 81, details of which are given. Another new gun, called a rare specimen, is the 30-mm. caliber M.G. 101, of which little is known beyond the fact that it follows the same general lines as the small German weapons. Italian guns are also described, these being stated to be comparatively small and of two types, both of Breda manufacture.

Concerning Japanese weapons it is stated that little is known. The one most frequently met is a Japanese modification of the Mark III Vickers and the type 92, a close copy of the Lewis. The writer concludes that the general impression gained from a study of the various weapons is that those of Italian and Japanese origin are of small account, whereas the German guns are all strikingly good in design, manufacture, and performance. Although there are evidences of savings in labor, the finish in important parts is as good as it ever was and performance is of a high order. The specifications of these guns are tabulated. *Aircraft Engineering*, April, 1943, pages 100–102, 8 illus.

Business and Finance

Aviation's Postwar Portents. H. L. Federman. A brief analysis of several factors that figure prominently in the aviation industry's financial outlook for the postwar transition period. Among the factors discussed are: the extensive participation of the government in aircraft plants and the problems these commitments pose; the decline of net property investment accounts in spite of mounting production schedules, which is regarded as a manifestation of the industry's strengthening financial position; the contingency reserves for postwar use which are being created both from earned surplus and from postwar refund of excess profits taxes to be funded by bonds receivable from the United States Government; and the trend toward standardization and improvement in the processes of contract renegotiation. An accompanying table lists the postwar contingency reserves of representative aircraft companies. *Aviation*, May, 1943, pages 120, 400, 401.

Factors and Flaws of Contract Renegotiation. Raymond L. Hoadley. The writer reviews the objections to contract renegotiation raised by the aircraft industry and other industrialists. One criticism is on the requirement of the law for renegotiation of contracts before, rather than after, excess profits tax. A second is the claim that contract renegotiation will impair working capital resources, particularly important in the case of the aircraft industry because of the adjustment period that will follow the termination of the war. Official suggestions with regard to permitting companies to set up postwar reserves without being penalized under the renegotiation or tax laws are outlined. Another defect in the law is stated to be the Government's failure to create a board of review to which disputed decisions of a price adjustment board might be taken on appeal. A fourth source of dissatisfaction is the lack of overall standards in the administration of renegotiation which would permit the contractor to anticipate the extent of renegotiation demands when it is necessary for him to know his exact assets and liabilities. The existence of four price adjustment boards —representing the Army, the Navy, the Maritime Commission, and the Treasury—with different methods of procedure, is indicated as a major cause for this absence of a uniform policy.

The article also includes some advice on procedures to be followed when renegotiation is under way. These suggestions are: (1) Do not argue the law or its constitutionality with the price adjustment boards. To hand down opinions and decisions of this nature is the role of Congress and the courts, not of the Government negotiators. (2) Remember that the work of the accountant is auxiliary. Briefs should cover not only accounting facts but also business facts, such as inventive contributions, efficiency, economy of operation, speed of deliveries, use of patents, and risks undertaken to fill Government contracts. (3) It does not help to bring along a political lawyer or a lawyer who has set himself up as a specialist in renegotiation when you come before a board. Board officials cite some instances where cases that could have been settled in 15 min. have taken four weeks or more with "lawyer-accompaniment"—with nothing beneficial accomplished by the political lawyer or specialist. *Aviation*, May, 1943, pages 121, 398–400.

Camouflage

Some Elements of Plant Camouflage. Harper Goff. Although stating that each plant or industrial area represents a different camouflage problem to be treated individually, the writer discusses certain basic camouflage principles that must apply in all cases. Using a pair of hypothetic models, he shows an imaginary factory area before and after a comprehensive camouflage design has been applied. All difficult problems of concealment are contained in the one example and the writer explains how each of these are overcome.

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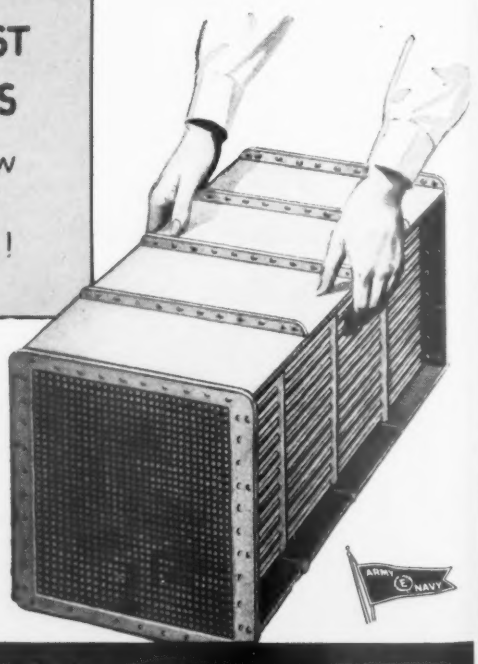

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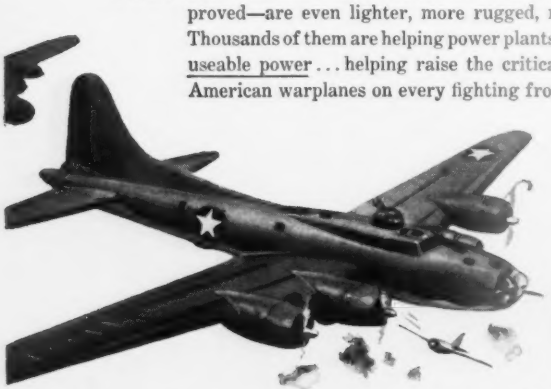

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Factors contributing to effective camouflage setups are examined. These include the importance of color and texture, cooperation and discipline throughout the camouflaged area, construction methods, and materials. The writer also stresses the fact that correct camouflage technique involves the maintenance of existing working conditions to as great an extent as possible. *Aero Digest*, May, 1943, pages 119–121, 347, 348, 11 illus.

Civil Air Defense

Army Flash! Highlights on the personnel and work of the Ground Observer Corps of the Army Air Forces are furnished. Examples of the many unusual adventures that befall members of the Ground Observer Corps are given. It is noted that the volunteers build their own towers, furnish their own cars and tires, and give freely of their time. Many of their spotter towers are elaborate, others are makeshift and crude, but all are effective. Some of the towers that have been built are described. *Air Progress*, June, 1943, pages 16, 17, 61, 62, 3 illus.

Globos De Barrera (Barrage Balloons). Jose Hijar. Barrage balloons and their uses. According to the writer England is outstanding in the practical use of this type of balloon. He investigates mathematically the technical characteristics of a balloon and its ability to resist wind pressure and then describes the various types of barrage balloons, especially those used in England. He considers the effects of atmospheric conditions on their maneuverability and discusses the manner in which these balloons may be most efficiently employed. *Revista De Aeronautica*, January, 1943, pages 15–19, 4 illus.

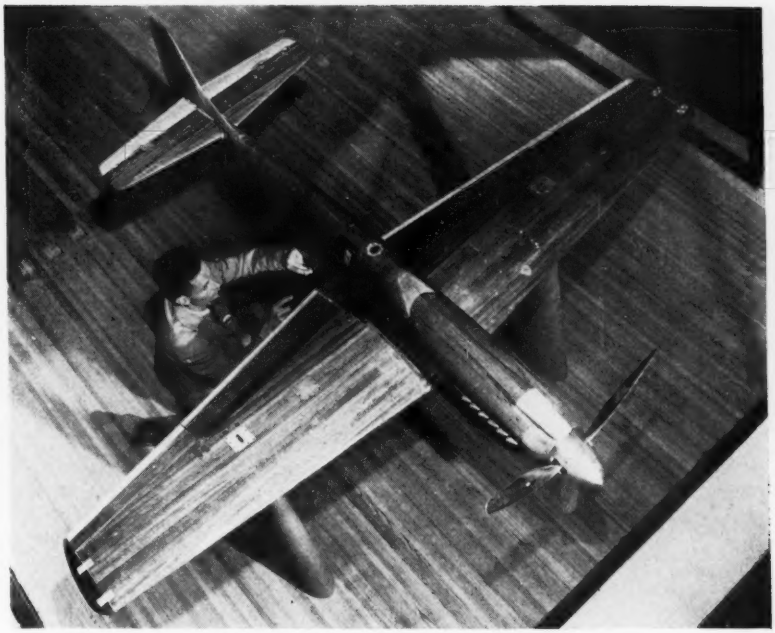
Civil Aviation

The Little Man Speaks Out. Reed Pigman. A fixed-base operator gives his reaction to the War Production Board's Order L-262—prohibiting the sale, lease, rental, or gift of any interest in any aircraft under 500 hp.—and its effect upon small operators. He describes the confusion arising from the question of whether the order referred to flight instruction and indicates wherein this phase of the order hampers, rather than aids, the war effort. His convictions regarding the ruling are summed up as follows: (1) Regulation L-262 has been hurriedly and faultily fabricated to be used as a club over the head of the small operator so that he would quit business quickly after losing his contracts and not be a stumbling block in the War Training Service program. (2) There has been a definite rift between the General Inspection branch of the C.A.A. and W.T.S. (3) It was not necessary to cancel out all the little operators and another program could be made to use them. (4) The Army and Navy do not relish the new program or any other program run by civilians to train their men.

The writer urges cooperation among the operators and outlines a group of suggestions for remedying the situations criticized—the elimination of small operators from the flight training program, lack of cooperation between General Inspection and War Training Service, training of military personnel by civilians, etc. He proposes that these be offered to the training director of the W.T.S. through the Association of Aviation War Activities, an organization of pilots and operators. *Southern Flight*, May, 1943, pages 42–44, 2 illus.

Hedgehoppers to the Rescue. Major H. S. Mazet. A description of the methods by which California's rice crop is sown from seeds dispersed by airplanes. Economy of time and man power is credited to the aerial rice-sowing operations. *Air-Age*, August, 1943, pages 26, 27, 50, 5 illus.

Metal Hunt. Elmar Machan. An account of how the Geological Survey of Canada's Department of Mines and Resources utilizes aircraft in its search for oil and metals in the northlands of Canada. Both in peacetime and wartime operations the Department employs airplanes for three basic purposes—air photography; reconnaissance; and the transportation of personnel, supplies, and equipment for topographic and geologic mapping of potential mineral areas. Since the Department possesses no aircraft of its own, it is dependent upon private companies to supply the planes. The article names types of aircraft used in northern exploration and men who have been active in this aerial search for minerals. *Canadian Aviation*, May, 1943, pages 72, 73, 116, 4 illus.



A model of the P-51 Mustang in the North American wind tunnel.

Design

Air Transports. C. A. H. Pollitt and J. H. Laver. The writers propose some designs for future civil and military landplane transport. Reasons for each suggested feature are discussed, but it is conceded that extensive wind-tunnel tests would be required before such projects could be initiated. Operational requirements are regarded as the chief controlling factors for the suggestions, with loading and stowage stated to have the greatest influence on transport fuselage design. The notes include comments on bomber adaptation, heavy freight transports, high-altitude planes for mail carrying, and buried-engine cooling. Drawings of the proposed designs are shown, accompanied by tables of specification data. *Flight*, April 15, 1943, pages 393–396, 7 illus.

Lofting Problems of Streamline Bodies. Part 13. Carter M. Hartley and Roy A. Liming. In the 13th installment of this study the writers proceed with their presentation of the application of conic lofting techniques

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to the development of air-frame components, including the development of a cockpit enclosure. The design and aerodynamic considerations are explored and the calculations for the intersection of the fuselage and the enclosure are developed. A mathematical calculation is worked out and explained. An alternative method is also given, with its equations, and drawings showing the plan and profile views are included. Charts aid the development of the curves.

The installment concludes with remarks on calculations of offsets for all fuselage stations that operate to establish governing conditions for the basic conics, and instructions are given for the interpolation of offsets in a table which tends to eliminate virtually the repetition of previous calculation steps. *Aero Digest*, May, 1943, pages 160, 163, 164, 5 illus.

Designing for Production. Part II. James E. Thompson. The second part of this article deals with simplification of the manufacture of aircraft and stresses the importance of planning for production economy during the process of designing machined parts. The practice of visualizing the machine work involved should be followed during all steps of the design process so that machinability may be attained. The work should be so arranged that standard tools can be used and the necessity for special equipment avoided both as a matter of cost and to expedite production. It is advised that limits and tolerances be made as generous as possible, to remove the complications of working to unnecessarily close values. Examples of changes in specifications and methods that brought improved efficiency are given.

The use of existing parts and standards is urged, as well as available materials and tools and the provision of alternate materials to allow the greatest possible latitude for procurement. Another factor that the designer should always keep in mind is the arrangement of the design to facilitate inspection and servicing. Adequate consideration given to assembly and accessibility will bring rewards in efficient production and satisfactory serviceability.

A table gives a summary of practical minimum limits or tolerances for machined parts produced by various machine tools and operations. *Western Flying*, May, 1943, pages 52–54, 56, 4 illus.

The American Way. David Vine. The writer comments on several differences between British and American aircraft. Among the dissimilarities he discusses are those connected with instrument positions, braking

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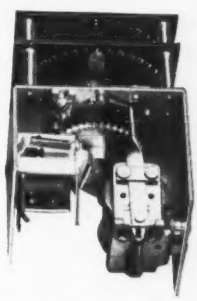

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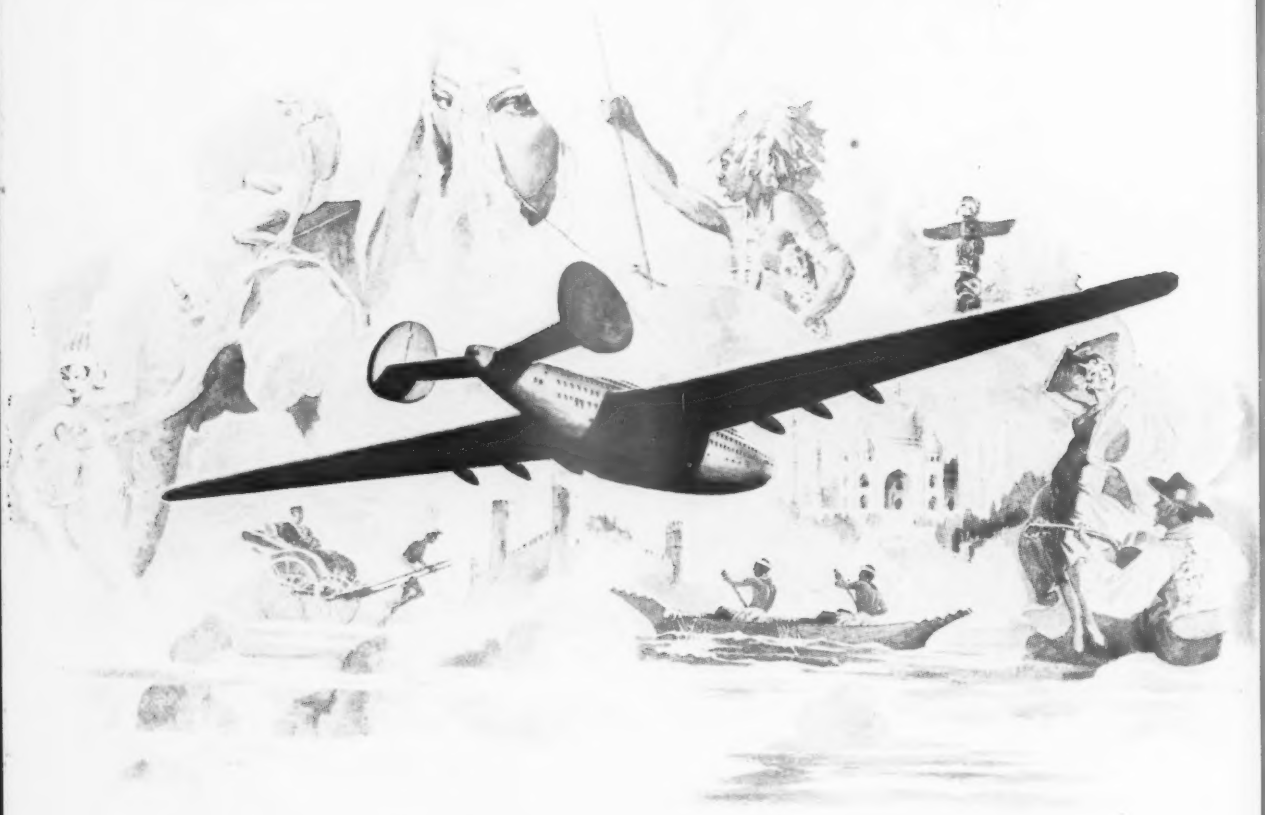

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systems, cockpit layouts, power plants, and auxiliary power. *Canadian Air Cadet*, May, 1943, pages 15, 28, 4 illus.

Cockpit Classification. Flight Lt. Gordon White. It is stated that the time has come when the question of cockpit layout should be settled. Standardization of cockpits is impossible in view of the numerous types of aircraft in commission and their widely differing purposes, but a system of uniformity should be decided on. The cockpit should be a matter for equally careful design and attention as any other part of an aircraft. A system of what is termed "cockpit classification" is presented. It is explained that the term means the classification of all instruments and controls into definite groups, then the practical layout of these groups in the cockpit, and the training required for the pilot. *Aeronautics*, June, 1943, pages 50, 51, 2 illus.

Asymmetrical Symmetry. Alexis Dawydoff. Advantages of the asymmetric type of airplane are reviewed. It is noted that there is nothing new about asymmetric aircraft and that T. P. Wright filed a patent in 1929 on what is called the first truly asymmetric airplane. Russian and German types of asymmetric aircraft are described. The chief object of this design is to obtain better visibility, but the other advantages in this arrangement are explained. *Air Progress*, June, 1943, pages 20–23, 5 illus.

Engines

Engine Progress 1918–43. G. Geoffrey Smith. In this outline of aircraft-engine development in Britain during the existence of the Royal Air Force, the writer compares the general features of early type engines with those produced in Britain today. He summarizes the technical progress of the past 25 years, indicates the trend of design, and notes the salient changes. *Flight*, April 1, 1943, pages 337–341, 20 illus.

Power Generation from Aircraft Engines. R. L. Findley. Means of recovering from 40 to 60 per cent of the electric power generated during test runs of aircraft engines are presented in this article. The economics of generating electric power with aircraft engines and the physical setup of the procedure are described.

After outlining methods of loading for production testing and the initial costs of various testing systems, the writer considers the costs, procedures, and advantages of alternator testing with slip type coupling, d.c. generator testing, and wound-rotor induction generator testing. He then discusses determination of engine brake horsepower, power determination with an alternator, and determination with wound-rotor induction generator.

Methods of protecting both engine and test equipment against dangerous or faulty operation through the use of power recovery apparatus are also recommended. Tabular information and diagrams are included in the article. *Aviation*, May, 1943, pages 162–165, 351, 352, 355, 356, 8 illus.

Carburetor Icing and Its Prevention. P. M. Ku. An outline of the latest findings on the problem of icing in aircraft-engine carburetors. The causes of icing are described and factors affecting the phenomenon and means of preventing icing are considered. In summarizing the subject the writer states that fuel vaporization is the major cause of carburetor icing but that the atmospheric humidity is the determining factor. Below 60 per cent relative humidity icing is not likely to occur. In order to combat ice hazard successfully, a careful design of induction system, with the least possible restriction and disturbance, is always necessary. Automatic warm and cold air intake offers an easy and promising solution for the average case. Addition of an ice inhibitor in conjunction with a suitable ice-detecting equipment is the only adequate means for all operating conditions and has produced more satisfactory results than other methods. *C.I.E. Journal*, April, 1943, pages 92–100, 6 illus.

Studebaker Builds Engines. Some notes about the Studebaker Corporation's accelerated program for the building of Wright Cyclone aeronautical engines at three new plants. Figures are quoted on the shipments of war material in 1942 and 1943. The article contains a brief description of the Greenlee cylinder head machine, which is described as one of the outstanding items of machinery used in these plants. *Commercial Aviation*, April, 1943, pages 89, 90, 5 illus.

Why Not Forged Engine Mounts? Chris Frey. The advantages of using forged engine mounts instead of welded types are given. The comparison lists some of the disadvantages that are encountered with welded mounts and then goes on to cite favorable factors accompanying the use of the forged mounts. Among the latter are low cost of stock, few subassemblies, utilization of unskilled labor, great strength, good machinability even at high tensile strength, easy assembly, and small shipping space. Diagrammatic drawings showing several views of a forged engine mount illustrate the text. *Aviation*, May, 1943, pages 176, 394, 395, 1 illus.

Antifriction-Bearing Developments for Aviation Engines. Thomas Barish. Steps in the development of antifriction bearings for past and present production radial aircraft engines are traced. It is explained that increases in power required improvements in roller bearings for crankshafts. Investigations made in 1938 produced relatively minute but extremely important internal changes that brought to use some of the unrealized possibilities of this type of bearings. Bearings for the following services are described in detail: crankshaft bearings, propeller thrust bearings, rocker-arm bearings, supercharger bearings, and controllable-propeller bearings. Tables contain data on the types of bearings used on present production engines.

For propeller thrust and radial loads, all but the smallest airplane engines are equipped with single-row radial ball bearings. The propeller bearing must carry a large momentary radial load because of gyroscopic forces. A table of propeller thrust bearing types for various makes of engines is shown. In discussing valve rocker arm bearings the writer notes that the location involves temperatures high enough to soften the common ball and roller bearing steels. For superchargers, extreme speeds and large power concentrations have been successfully met with the same super-precision ball bearings originally developed for high-speed glider spindles. Controllable-propeller blade bearings must be designed to withstand extremely large centrifugal forces, aerodynamic forces at large overhangs, and the severe tendency to vibrate and false-brinell. *Transactions of the A.S.M.E.*, May, 1943, pages 261–266, 11 illus.

Production Speeded on Welded Seam Inlet Elbows. A description of how the Buick Motor Division of General Motors Corporation fabricates inlet elbows for Pratt & Whitney aircraft engines. Their method employs welded tubing in place of the seamless steel tubing formerly used. In addition to manufacturing the tubing itself, the company cuts it to length, forms it into elbows, sizes the elbows, paints them, and then ships them to engine assembly plants. Forming and welding of the tubing are done by one specially built machine. It is stated that because of this careful manufacture the welded inlet

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tubes have proved equal in service to the seamless type. *Aviation*, May, 1943, pages 199, 393, 3 illus.; "Buick Builds Welded Steel Manifolds," *Flying*, June, 1943, pages 106, 115, 3 illus.

Trend of Aircraft Engines—Five Years in Retrospect. C. H. Wang. Major achievements in the advancement of aircraft-engine designs during the past five years are reviewed. The subject of air-cooled versus liquid-cooled engines is discussed. The main performance characteristics of engines at the beginning of the period under review are compared with those of recent aviation engines. Engines that are still in the development stage are named. It is reported that Wright has developed a 32-cylinder liquid-cooled, horizontally opposed engine of 3,200 hp., in addition to a projected six-row radial 42-cylinder engine of 3,000–4,000 hp. It is indicated that the anticipated trend toward engines, with a larger number of small cylinders operating at high speeds has been somewhat realized. Other sections of the article deal with propellers, jet propulsion, integral power units, fuels, carburetion versus fuel injection, cooling, supercharging, and engine dynamics. The article concludes with a few remarks on production and research. *C.I.E. Journal*, April, 1943, pages 101–109.

P & W Twin-Wasps Sting the Axis. An extensive description of the Pratt & Whitney twin-Wasp C3 engines is given. To aid the reader in understanding design features, illustrations are provided, some of which are in color, accentuating the various engine components and accessories. Sections of the article deal with the main crankcase action, the blower section, the intermediate section, and rear section. Further servicing of the engine is described. *Air Tech*, May, 1943, pages 50–54, 66, 70, 12 illus.

Flight Technique

Power Control. R. Dixon Speas. The writer defines the purposes and basic factors involved in the proper control of an airplane's power and gives instructions on how to fly an airplane in accordance with each type of operation. He states that the basic purposes of power control are to accomplish one of the following items for each flight: (1) stay in the air as long as possible (Maximum Endurance); (2) fly for as great a distance as possible (Maximum Range); (3) fly as fast as possible (Maximum Speed); (4) fly at a specified constant power (Intermediate Power Operation); and (5) carry the greatest amount of load between two points (Maximum Pay-load Miles per Hour).

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The attainment of each goal is discussed under the respective technical headings. *Air Facts*, June, 1943, pages 21–26.

The Simple Truths of Flying. G. J. Dunkleberg. A discussion of the technique required for the performance of the four basic flight maneuvers. These fundamentals are defined as (1) straight and level flight, (2) the climb, (3) the glide, and (4) the turn. The article also touches upon operation of the controls, maintenance of flying speed, and procedures of take-off and landing. *Southern Flight*, May, 1943, pages 24, 28, 1 illus.

Common Sense and Plenty of Gas. S. P. Alexander. An air-line pilot discusses some of the reasons for the excellent safety records of the air lines. Observation of the following rules is credited as a major factor in the record: Possess a knowledge of, and experience with, the type of equipment one is operating; ascertain that in case of emergencies a margin of gasoline is always available; never make instrument or semi-instrument approaches into unfamiliar fields; and do not depend on one method of navigation for cross-country flying, but use three methods—pilotage, radio, and dead reckoning—to maintain a constant check. *Air Facts*, June, 1943, pages 28–31.

Natural Formations. A. Falorde. It is recalled that the first knowledge of the principles of flying heavier-than-air craft was obtained by observing the flight of birds. Sufficiently close observation of the formation flying used by birds is suggested as a method of achieving notable advances in artificial formations. Natural formations of birds in flight are studied. Possible aircraft formations suggested by the study are discussed. *Aeronautics*, May, 1943, pages 36–39, 9 illus.

The Laws of the Turn. Wolfgang Langewiesche. A statement is made of the laws that govern the turning of an airplane in flight and how they affect the pilot, but the mathematical connection is not discussed. It is shown that ability to turn depends upon three factors: speed, ability to maintain a steep bank, and the quickness with which the plane can assume a bank. The action of the rudder and the ailerons is explained, and comparisons are drawn between the turning performance of monoplanes, biplanes, and gliders.

The same laws apply to upward turns as to lateral turns. Examples of combinations of upward and sideward turns, nose-down stalls, and loops are given. Advice is offered concerning diving and the relationship between the laws of the turn, wing loading, and landing space. Factors of time and space are explained, as well as the differences in handling planes with heavy and light wing loading. *Air Facts*, June, 1943, pages 43–52, 4 illus.

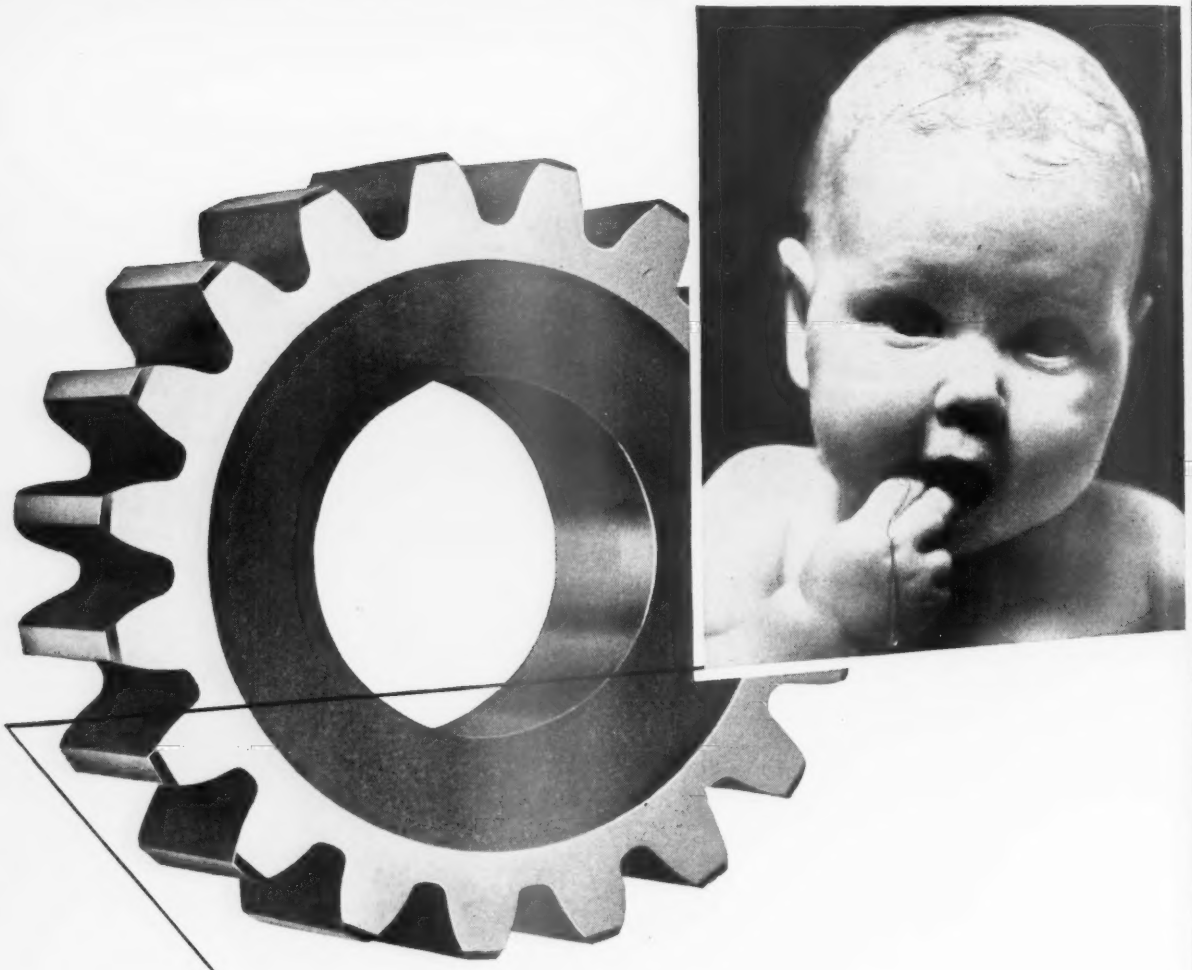
Fuels

Fuels and Internal Combustion Engine Performance. J. L. Beilschmidt. The effect of fuel composition on the performance of internal combustion engines is discussed. The fundamental thermodynamic principles of combustion in the cylinders of gasoline engines are set forth in considerable detail. Sections of the article cover the composition and calorific value of the charge, the combustion process, the temperature of the combustion, and the Carnot cycle. *Aeronautics*, May, 1943, pages 48–54, 8 illus.

Gliding and Soaring

Glider "Gen" and Generalities. Group Capt. D. C. M. Hume. Some fundamental information on gliding is presented. The essential differences between primary, secondary, and war gliding are explained and the value of primary gliding is stressed. A series of brief notes depict several highlights in the development of gliders from Lillienthal to the present war. *Canadian Air Cadet*, May, 1943, pages 7, 23, 1 illus.

Gliders for Transport. Major Lewin B. Barringer. Airplane towing of gliders was first carried out as a method of launching a glider at a height and location where contact with rising air currents could be made for a soaring flight. After this method of launching was proved practicable, a considerable amount of towing was done, definite techniques were developed, and further knowledge was gained. The writer describes his impressions when piloting gliders in early tow plane flights. Some of the difficulties encountered are explained



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and present trends in transport and glider design are referred to. The possibility of substantially increasing cargo capacities during the war by towing cargo gliders behind cargo airplanes is discussed. *Soaring*, January-February, 1943, pages 3–5, 1 illus.

War Gliding. A summary of current glider activities in England. Details on the training of British glider pilots, the equipment used, and the gliding techniques that are taught are given. *Canadian Air Cadet*, May, 1943, pages 8, 9, 22, 5 illus.

History

A Quarter of a Century. Major F. A. de V. Robertson. On the occasion of its 25th birthday, the history of the R.A.F. is recounted. The structure of the organization and its development to its present form are reviewed. It is shown how the R.A.F. was formed during the latter part of the first World War by a consolidation of the Royal Flying Corps and the Royal Naval Air Service, how it was drastically reduced at the end of the war, reorganized in later years, and then expanded when the likelihood of the present war appeared on the horizon.

The article also deals with R.A.F. titles of rank, its reserve, cadet and staff colleges, and technical training schools for aircraft apprentices. Photographs of several men responsible for Royal Air Force progress are included. *Flight*, April 1, 1943, pages 343–348, 27 illus.; "R.A.F. Silver Jubilee," *The Aeroplane*, April 2, 1943, pages 385, 386, 5 illus.; "The Genesis of the R.A.F.," C. G. Gray, *The Aeroplane*, April 2, 1943, page 387, 8 illus.; "The Years Between," J. M. Speight, *The Aeroplane*, April 2, 1943, pages 389–391, 13 illus.; "Twenty-five Years of Progress," Peter Masefield, *The Aeroplane*, April 2, 1943, pages 394–396, 7 illus.; "The First Quarter Century," Harold Crary, *National Aeronautics*, May, 1943, pages 14, 15, 34, 5 illus.

R.A.F. Squadrons—1918. A list of Royal Air Force squadrons is given for the year 1918. This tabulation is stated to be not absolutely complete but includes most of the units operating in October, 1918. The squadron number, aerodrome, commanding officer, airplane type, and purpose are shown. *The Aeroplane*, April 2, 1943, page 388.

Henson's "Aerial Steam Carriage," 1843. J. E. Hodgson. An article on the invention of the first power-driven airplane, claimed to have been designed by W. S. Henson. It is stated that Henson was the first man to conceive and design in almost all necessary detail a power-driven flying machine that conformed to the requirements for having "a surface support a given weight by the application of power to the resistance of air." The article describes Henson's work as a pioneer of mechanical flight and outlines the essential features of the monoplane design. It also includes material reporting the results of numerous experiments, made specifically in connection with Henson's monoplane, carried out by John Chapman in 1843. These experiments and observations were concerned with some of the basic principles of aerodynamics and design upon which any successful airplane must depend. *The Journal of The Royal Aeronautical Society*, April, 1943, pages 118–128, 1 illus.

Air Mail Celebrates Its Silver Jubilee. The recent celebration of the 25th anniversary of the establishment of commercial air-mail service recalls the story of the first regular air-mail flight, made in 1918. This first flight carried out by Lt. George L. Boyle of the U.S. Army Air Service is described. It is pointed out that the establishment of the first regular air-mail route between Washington and New York proved to be the nucleus of a network of air-mail lines which now cover not only the United States but the entire world. *Air Transportation*, May, 1943, pages 14–17, 5 illus.; *U.S. Air Services*, May, 1943, pages 9, 10.

Inspection

Exemplary Inspection System Is Foolproof and Time-Conserving. As the result of using gauge boxes, gauge boards, and a well-planned system for segregating rejected parts, it is claimed the Nash-Kelvinator Corporation has reduced the chances of human error to a minimum, eliminated breakage, and saved time in their inspection operations for Hamilton-Standard hydromatic propellers, which they manufacture. The gauge box, the gauge board, and the segregation system are described.

In the manufacturing departments, each operator is provided with a gauge box fitted with the necessary recesses and slots to hold plug, snap gauges, etc., arranged in the order in which they will be used on the part being machined. An improvement on the box, the gauge board is used where parts are small and easily handled. It is made of heavy plywood on which snap, plug and ring gauges, and dial indicator gauges are permanently mounted, ready for use. *Aero Digest*, May, 1943, pages 193, 295, 4 illus.

Instrument Flying

Instrument Approach by Radio Direction Finder. Part I. C. H. McIntosh. The first section of a two-part article covers accurate methods of approach by loop direction finder, using nondirectional radio beacons, a system that the writer holds has not been so widely adopted in this country as its value deserves. Now that the demands of air transport have required operations beyond the continental limits of the United States, where established radio ranges are not readily available, it is indicated that nondirectional radio beacons can be safely used in conjunction with aircraft direction-finding equipment to execute an instrument approach. Conceding that numerous methods exist for this purpose, the writer states that current misconceptions warrant a new study of the whole problem.

The fundamental information that must be in the pilot's possession is reviewed, and two types of procedure are explained by which the pilot can devise a method of approach to airports that lack specific direction-finder approach procedure. Instructions are given for making the initial approach and boxing the station under conditions where there is no wind. The procedure of boxing is analyzed and detailed instructions are provided for compensating for moderate winds. An example is worked out for the descent to the field. Operations under conditions of higher wind velocity will be taken up in the second part of the article. *Aviation*, May, 1943, pages 224, 225, 371, 373, 375, 2 illus.

Instruments

How Fast? The operating principle of typical air-speed indicators, with information on indicator corrections, is described and hints on maintenance are given. Diagrams are provided to aid the explanations. *Air Tech*, May, 1943, pages 16–18, 70, 8 illus.

Gyro Horizon Indicator. Dean P. Kelley. This is the first of a series of three articles on the Sperry gyro-horizon indicator, directional gyro, and automatic pilot. It covers operation and maintenance aspects of the gyro horizon, an instrument that shows the pilot whether the airplane is banking, climbing, gliding, or flying level. The gyroscope principle on which the instrument operates is described. Colored illustrations show the mechanical design of the instrument. *Air Tech*, May, 1943, pages 54–58, 8 illus.

Volume Production of Auto Pilots. An account of how the AC Spark Plug Division of General Motors achieved quantity production of automatic pilots. The changing of the sequence of operations to provide the proper "flow" of pilots is one method noted. Another is the introduction into automatic pilot manufacture of such innovations as a bearing riser that cleans ball bearing assemblies of all dust, lint, oil, and even moisture; a bearing tester that detects the increase in diameter of the balls when they become hot; a fixture on which the wiring harness is assembled and soldered outside the main casting; and a fixture by which some 15 plug and cable assemblies can be tested simultaneously instead of individually. Precautions that insure a high degree of accuracy in manufacture include the continuous running of grinders to avoid the errors that might occur if the machine were allowed to cool off; machines kept away from sunlight because the heat of the sun would disturb the accuracy of the setting of the machine; assembly of the bearings into the pilot under glass; and temperature-controlled rooms. *Aero Digest*, May, 1943, pages 195, 197, 7 illus.

An inspector at United Air Lines' central maintenance base using power glasses to check the various steel parts of a Mainliner engine.

Maintenance

Gipsy Major I Overhaul Period Extended. The writer describes how the first engine to run the claimed world's record service time of 1,260 hours was rebuilt for future service. The engine was a Gipsy Major I taken from a Tiger Moth plane used at an elementary flying training school. It is stated that, in rebuilding the engine for its next 1,260-hour run, the only parts that had to be scrapped and repaired were eight valve guides, one engine set of piston rings, one set of high-tension leads, one cooling baffle, and four rocker box stirrups and nuts. *Air Force Review*, June, 1943, pages 14, 26, 5 illus.

Setting Up the Engine Overhaul Station. Joseph R. Horton. This article contains the account of how the Embry-Riddle Company enlarged its Miami, Fla., overhaul facilities to accommodate the maintenance of Army training-plane engines. Problems of time shortage, production, insufficient personnel, and inadequate equipment were encountered. The writer tells specifically how each of these was solved. *Aviation*, May, 1943, pages 231, 232, 235, 363, 364, 367, 9 illus.

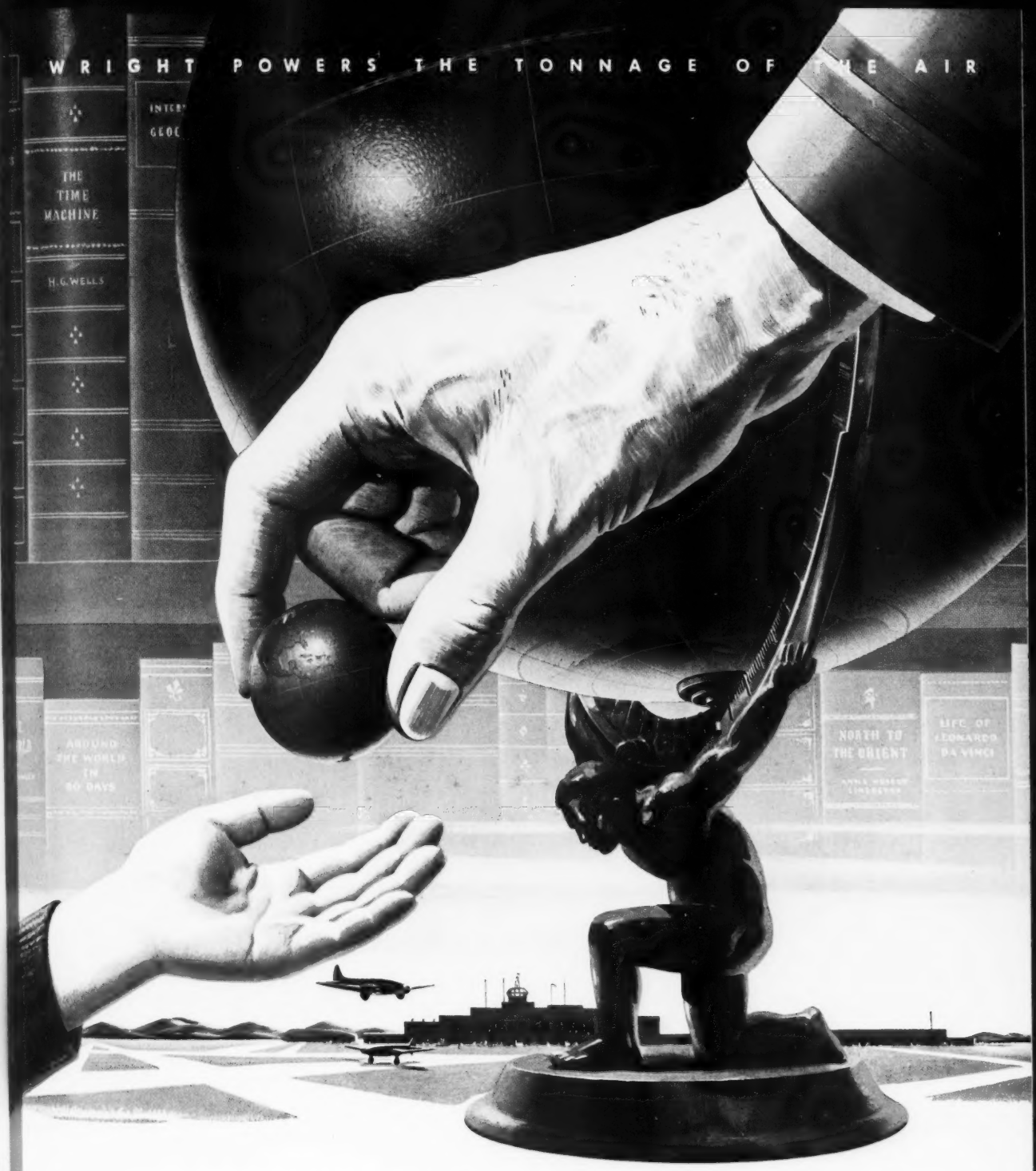
Maintenance Abroad. Ralph Michaelis. The maintenance of military aircraft is discussed. It is stated that every time 1,000 bombers take to the air for bombing operations about 50,000 men and women of the Royal Air Force are directly involved. Nearly 90 per cent of the number remain on the ground and the majority of these are concerned with the maintenance and servicing of the plane. How this work is carried out in the various war theaters is described. *Air Tech*, May, 1943, pages 24, 62, 1 illus.

Management

Efficient Production Management Achieved by Careful Controls. Part II. C. H. Speck. The concluding installment of a two-part article on production management deals with the production and material control departments. The organization of a typical production control department is outlined, its procedures are described, and the functions are given of each department operating under it. Indicating briefly the type of personnel which makes an efficient production control department, the article also traces the progress of an order through the shop. The production control department is defined as that group which directs the actual performance of the plans of production management. As set forth in the article, its subdivisions consist of: scheduling, subcontracting, expediters, control points, stockrooms, and dispatchers.

The material control department is described as the department that controls all materials from the time they are "production released" on a blueprint by the engineering department, until they assume the form of parts and are actually delivered to the production line for fabrication. Listing the subdivisions as the material control general office, purchasing department, scheduling and priority division, material requirements division, purchased parts and raw materials stockroom, and auditing section of material control, the writer analyzes the functions of each division. *Aero Digest*, May, 1943, pages 173, 175, 177, 179, 288, 9 illus.

Quality Control at Ryan. Keith Monroe. The purpose, procedures, and advantages of the Ryan Aeronautical Company's quality-control system are described. Instituted to accelerate the correction of parts that are not being produced exactly to standard, the system consists of a few inspection-discrepancy reports and a rigid follow-up. The article relates several typical instances in which the quality-control department has saved production time and material. It also tells of the men who are responsible for its efficient functioning and administration. *Western Flying*, May, 1943, pages 48, 49, 92, 94, 3 illus.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Mr. Miller, in his speech reported in the above news item, pointed out the value of weight saved in a *commercial plane*. "When *military* operation is considered," said Mr. Miller, "the result can be even more staggering."

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Materials

Non-Ferrous Alloys for Airframes and Engines. J. B. Johnson. Preceded by a brief discussion of the properties of nonferrous alloys and the types used for aircraft applications, a two-page table of nonferrous alloys for air frames and engines is presented. This table represents the Government and commercial specifications that are widely used in the aircraft industry. It shows the specification numbers, materials, heat-treatment, nominal chemical composition, and mechanical properties of each item. A 24- by 18-in. enlargement of the table is offered free to executive engineers by the Materials Laboratory, Engineering Division, A.A.F. Matériel Command. *Aero Digest*, May, 1943, pages 169–171.

Hydraulic Efficiency of Rubber Pads. Warren Tucker. A series of tests, undertaken to establish the degree of fluidity of rubber used as a pad in hydraulic presses, is described. An ideal hydraulic fluid efficiency is defined, and comparisons are made between the unattainable ideal and the best practical solutions that have yet been achieved. The equipment used in the experiment is also described.

The procedure is detailed step by step. It is stated that the effect of friction between the rubber and the container wall is noticeable but slight and can be neglected on a large pad. It is concluded that when rubber is used as the hydraulic fluid the pressure per square inch available for useful work is 90.5 per cent of that applied. The results of the tests are tabulated and drawings illustrate the equipment used. *Aviation*, May, 1943, pages 167, 169, 360, 4 illus.

Low-Carbon Steel Replaces Critical Tool Steel as Die Material. George Lewis and Guy Nash. The writers describe how North American Aviation is successfully employing low-carbon tool steel, flat-plate punch press dies in order to save critical material and labor. It is stated that with the new procedure highly experienced diemakers are unnecessary and material costs are less. It has been found that the life of low- or medium-carbon tool steel dies is suitable for the average run of aircraft parts. Forty detailed steps are listed for the fabrication of a typical flat-plate die. *Wings*, May, 1943, pages 482, 483, 4 illus.

A High-Strength, Natural-Aging Aluminum Alloy. Hiram Brown. A detailed discussion of the properties, characteristics, uses, and advantages of a comparatively new aluminum alloy. Known commercially as Frontier 40E, the metal is a patented aluminum-zinc-magnesium-chromium-titanium alloy. Frontier 40E is claimed to meet requirements of strength, shock resistance, and corrosion resistance. It possesses desirable physical properties without high-temperature heat-treatment or quenching. Castings from this alloy are reported to have shown consistent soundness and its machinability is said to be excellent. *Aero Digest*, May, 1943, pages 209, 210, 296, 333, 2 illus.

Forged aluminum pistons and steel crankshafts are shown in this view of the Wyman-Gordon Company's Forge Shop.

Medicine

Limits of Human Heat Regulation. L. H. Newburgh, L. P. Herrington, and A. P. Gagge. A report on an investigation of the limits of what is described as the human mechanism that maintains the balance of the internal temperature of the human body at a nearly constant level in spite of the varying production of internal heat and the wide range of ambient temperatures to which it is exposed.

When the air temperatures are at desert levels, it may be impossible for the individual to lose heat at the rate at which he is producing it. The increasing heat load causes a number of manifestations varying from lessening efficiency to sudden collapse, which may be fatal. In contrast, prolonged external cold may cause loss of heat at a rate greater than the production of heat. The consequent cooling of the extremities in the early states interferes with the movements of the hands and feet. Continued exposure causes great discomfort and may result in serious injury to the hands and feet. Equally important is the prolonged fatigue that results from the cooling of the internal organs.

The report covers the conversion of food into kinetic energy, the internal and skin temperatures, and the functions performed by clothing. The experiments performed are described. Information about protective measures against cold and the effects of temperature and humidity is given. *Journal of the Aeronautical Sciences*, June, 1943, pages 197–199.

New Results and Problems in Medical Stratosphere Research. H. Strughold. Translated from *Luftwissen*, June, 1942. The general problem of high-altitude flight can be resolved into two questions: How and with what technical aids is penetration into the stratosphere possible with the preservation of full efficiency; and how can emergence from the stratosphere be safely effected in the case of failure of the technical aids? It is known that the introduction of auxiliary oxygen-breathing equipment has enabled the substratosphere to be utilized for human flight, and the introduction of pressure cabins and

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flying suits has made possible penetration of the stratosphere itself.

To illustrate the mode of operation of the technical aids to high-altitude flight and the limits of their application, the writer describes the effects of altitude in the region of the troposphere. He continues with a discussion of physiologic and other effects at higher altitudes. The question of safe emergence from the stratosphere in the case of failure of the pressure cabin auxiliary oxygen-breathing equipment through enemy action or other causes is discussed. *The Journal of The Royal Aeronautical Society*, April, 1943, pages 113–117.

I. Appraisal of Tests of Altitude Tolerance. Alvan L. Barach, Lt. Robert Brookes, Morris Eckman, Emanuel Ginsburg, and Artell E. Johnson. The observations recorded in this paper are control measurements made prior to another investigation on the effect of certain drugs on altitude tolerance. Sixteen normal subjects were studied in a decompression chamber at a pressure of 428 mm. Hg, equivalent to an altitude of 15,000 ft., two to four times a week for eight to twelve weeks. The duration of each exposure was 1¾ hours. A series of physiologic and psychometric tests was selected to measure each individual's response to this degree of anoxia.

The writers conclude that, although these tests are considered necessary to an evaluation of the beneficial or ill effects of a drug or new procedure in a given individual exposed to altitude anoxia, they did not appear to be reliable criteria for pilot selection. In the short psychometric tests employed in this study, an increased conscious effort in many instances compensated in large part for the impairment due to anoxia.

The changes in affective behavior, however, appear to contribute significant evidence of altitude intolerance in respect to anoxia. These changes were manifested either by depressed, sleepy states or by unduly excited, euphoric, irritable or pugnacious moods. In two members of the impaired group, the disturbance in emotional control was sufficiently marked as to raise serious doubt regarding their fitness for flying. *The Journal of Aviation Medicine*, April, 1943, pages 55–62.

II. Impairment of Emotional Control as a Test of Altitude Anoxia. Alvan L. Barach, Lt. Robert Brookes, Morris Eckman, Emanuel Ginsburg, and Artell E. Johnson. In this paper the writers suggest a practical test of altitude anoxia that can be carried out on a large number of candidates for flying without undue expense of

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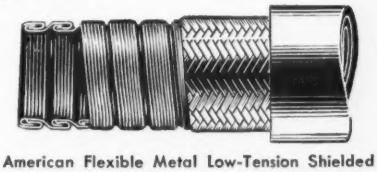

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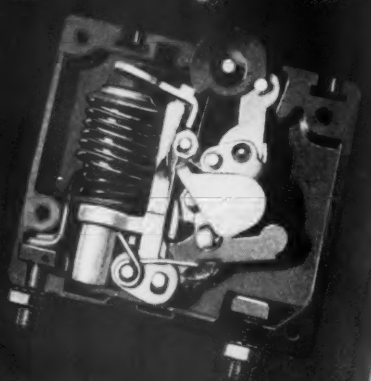

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time. The test consists of observation of the extent of impairment of emotional control brought on by exposure to a simulated altitude of 15,000 ft. for 1 to 2 hours. In the previous paper (Part I) no correlation was found between exact physiologic and psychometric tests and disturbances in affective behavior. Although estimation of impairment in emotional control is a qualitative test, it appears to furnish information of more significance concerning the potential candidate for flying than quantitative tests employed in the investigation cited above.

The assumption is now made that pilot selection is chiefly concerned with the attempt to weed out the unsafe flier, the man who would be prone to have accidents. It is further assumed that pilot training will ultimately separate the skillful from the less skillful aviator. In this appraisal of pilot testing, attention is focused on the specific problem of eliminating only the candidate who might be unsafe to handle a plane if he were exposed to a moderate altitude without oxygen—namely, 15,000 ft. for 1 or 2 hours. Under these circumstances the loss of the power to inhibit instinctive impulses is considered dangerous, since judgment and reason may be seriously disturbed as a result. It is concluded that impairment in emotional control produced by exposure to a 15,000-ft. altitude is a more reliable test of the potentially unsafe flier than more quantitative physiologic and psychometric tests. Although observation of disturbances in affective behavior is qualitative, it has the advantage of contributing significant information concerning a man who may be exposed to moderate anoxia in flying. It is believed that further study in methods and in the interpretation of clinical data is warranted. *The Journal of Aviation Medicine*, April, 1943, pages 63–70.

Have You Been Grounded? Sedley Peck. An article on the medical certifications of the C.A.A. tells how initial and periodical examinations determine the physiologic fitness for flying of civilian pilots and civilian pilot candidates. It also describes how the C.A.A. qualifies its decisions with liberal judgments and further tests under actual flight conditions for pilots whose exceptional flying ability and experience compensates for their physical deficiencies. The routine of issuing medical certificates is related. Structural, organic, and eye defects are discussed, with the writer indicating how fairness to handicapped applicants is evidenced. Some data are given on the specialized tests, methods of correction, and waivers of certain physical standards for

those with structural and eye defects. *Flying*, June, 1943, pages 68, 70, 154, 156, 158, 3 illus.

Development of a Medical Service for Airline Operations in Africa. This is the beginning of a two-part article recording the establishment of the Pan American Airways Medical Department in Africa and its 14 months of experience. The first topical discussion deals with general problems encountered by the medical department. One of these was the care of personnel scattered over great distances. Another was the varied geographic conditions that had to be considered in the prevention and control of disease.

The second discussion reviews the selection of personnel under subheadings of medical officers, technical assistants, nonmedical personnel, inoculations, and the effect of the tropics on personnel. The third section of the current installment covers hospitals, dispensaries, and equipment. The fourth discusses preventive medicine. This is followed by a detailed report of the department's experience with a specific disease—malaria. Data are included on screening; insecticides; larvicidal measures; drainage; chemical and personal prophylaxis; location of native compounds; and epidemiology, symptomatology, and treatment. *War Medicine*, May, 1943, pages 484–497.

Comments on Aviation Medicine for the Navy for 1942. Capt. J. C. Adams. Navy policy pertaining to training of flight surgeons and the need for aviation medical research are discussed in the light of recent developments. Navy research and operational accomplishments are outlined. Describing action against the enemy, the writer emphasizes the development value attached to flight surgeons and medical officers who are taking their share of the hazards. It is stated that permission has been granted for the training of a number of flight surgeons each year as qualified pilots leading to the designation of Naval Aviator. The insignia for Naval flight surgeons are described. *The Journal of Aviation Medicine*, April, 1943, pages 71–74.

Health Conservation in Airplane Manufacturing. F. E. Poole. Based on an address delivered to the 31st annual Congress of the National Safety Council by the Medical Director of the Lockheed and Vega Aircraft Corporations, this article outlines the medical program followed by aircraft companies to reduce the amount of absenteeism caused by illness and accidents.

The writer describes the preventive policies applied and touches upon methods of first aid and health education. His discussion is divided into four parts, one of which deals with occupational accidents, another with nonoccupational accidents, the third with occupational diseases, and the last with nonoccupational illnesses.

Adjustment of the individual to the physical requirements of a particular job is considered also in this article. It is stressed particularly in relation to the present necessity for hiring people who are physically handicapped in one way or another. *Western Flying*, May, 1943, pages 40, 41, 88, 1 illus.

Some Mental Aspects of Aviation Medicine. Eugene G. Reinartz. Discussing the progress in aviation medicine, the writer points out that the flight surgeons must always be in the vanguard of this development. The symptoms and etiology of aeroneurosis, which is defined as "staleness" or chronic functional nervous and psychic disorder occurring in aviators, are discussed and problems connected with prophylactic treatment are described. The distinction between aeroneurosis and the syndrome known as "flying stress," or operational fatigue, is referred to. The effects of repeated anoxia on the brain are considered, and the symptoms and treatment of aeroembolism are described. *The Journal of Aviation Medicine*, April, 1943, pages 75–83.

The Medical Service of the American Volunteer Group. Lt. Col. Thomas C. Gentry. The flight surgeon in charge of the medical care of the Flying Tigers discusses the methods by which he and his associates achieved the record of not having a single death due to illness occur in the A.V.G. during the year spent in Burma and China.

He designates the diseases that constituted the greatest threats to the health of the fliers and denotes those factors which proved most important in the prevention of illnesses. Malaria caused the most trouble. Homesickness and flying fatigue were two other serious considerations. *The Military Surgeon*, May, 1943, pages 491–494.

Psychological Factors in the Training of Airplane Pilots. José Rául Delucchi. The paper covers an attempt to describe and evaluate the psychologic training of airplane pilots and to indicate how such training can be initiated by means of common sports and amusements engaged in collectively. The fundamental psychologic functions to be considered in the appraisal of a candidate's personality are enumerated. Tables give the order of importance in which various sports and amusements call for certain physiologic functions. It is stated that the most appropriate sports for the purposes outlined in this paper would seem to be tennis, squash, golf, table tennis, basketball, croquet, and swimming. *The Journal of Aviation Medicine*, April, 1943, pages 84–87.

Metallurgy

Elevated Temperature Aging of 24S Aluminum Alloy. Paul P. Mozley. The aging of strong aluminum alloys at elevated temperatures is not a new process and the attainable physical properties have been studied for a number of the alloys used in aircraft construction. However, the fear of corrosion difficulties and the lack of detailed information regarding the physical properties obtainable and the optimum conditions of time and temperature required to attain these desired properties for 24S alloy have delayed the application of this process in aircraft fabrication up to this time.

Various combinations of time and temperature will produce similar results, but the most satisfactory treatment for 24S aluminum alloy appears to be at 375°F. for 8 hours. This treatment will raise the tension yield point of the material approximately 50 per cent and the ultimate tensile strength about 10 per cent, while at the same time the elongation is reduced to approximately 5 per cent in 2 in. In general, after aging treatments, the physical properties in compression are slightly lower than in tension.

The corrosion resistance of aluminum-coated sheet is not seriously impaired but that of bare 24S alloy is appreciably lowered. Elevated temperature aging of bare 24S in thicknesses below $^3/_{16}$ in. is not advisable because of the increased tendency for intercrystalline corrosion.

The maximum physical properties obtainable by aging with any combination of time and temperature are largely dependent on the elastic strain present as a result of cold-work performed after the solution heat-treatment and before the elevated temperature aging. In order to assure consistent physical properties after an elevated temperature aging has been performed, it is necessary to control the degree of cold-working which the material undergoes during its manufacture. *Journal of the Aeronautical Sciences*, June, 1943, pages 180–184, 5 illus.

Meteorology

On the Mechanism of Thunderstorm Downdrafts. Henry G. Kaplan. If a unit of air starts to descend in a region of the atmosphere characterized by a lapse rate between dry and saturated adiabatic, it becomes warmer than its surroundings and tends to return to its original position. However, in air where such a vertical temperature distribution exists, violent downdrafts are observed after the onset of a thunderstorm. Continuous cooling of the descending units of air by water and ice hydrometeors keeps them cooler than the surrounding air. Thus a downdraft is maintained.

The cooling can be divided into several factors. The most important is the heat of vaporization of the heavy precipitation falling with or through the descending units. The precipitation keeps the downdraft practically saturated, so that a plot of the path of a descending unit of air on an adiabatic chart will follow a saturation adiabat.

Other factors described in the order of their importance are the specific heat of the large quantities of water and ice accompanying or passing through each unit of descending air and the melting of ice hydrometeors, a factor that does not have the continuous cooling properties of the first two but is of considerable importance. It is shown that falling raindrops and ice hydrometeors, by compressing air ahead of them and rarifying air behind them, contribute to the downward motion of the air.

The sum of these effects, each of which has an importance depending upon particular conditions, makes up the characteristics of the downdraft. Downdrafts having a greater horizontal component than the accompanying precipitation, may leave the precipitation zone, and continue to descend dry adiabatically until they acquire the same temperature (or better, the same density characteristics) of the surrounding air. Those leaving the precipitation at a low level may reach the earth as a cool wind un-

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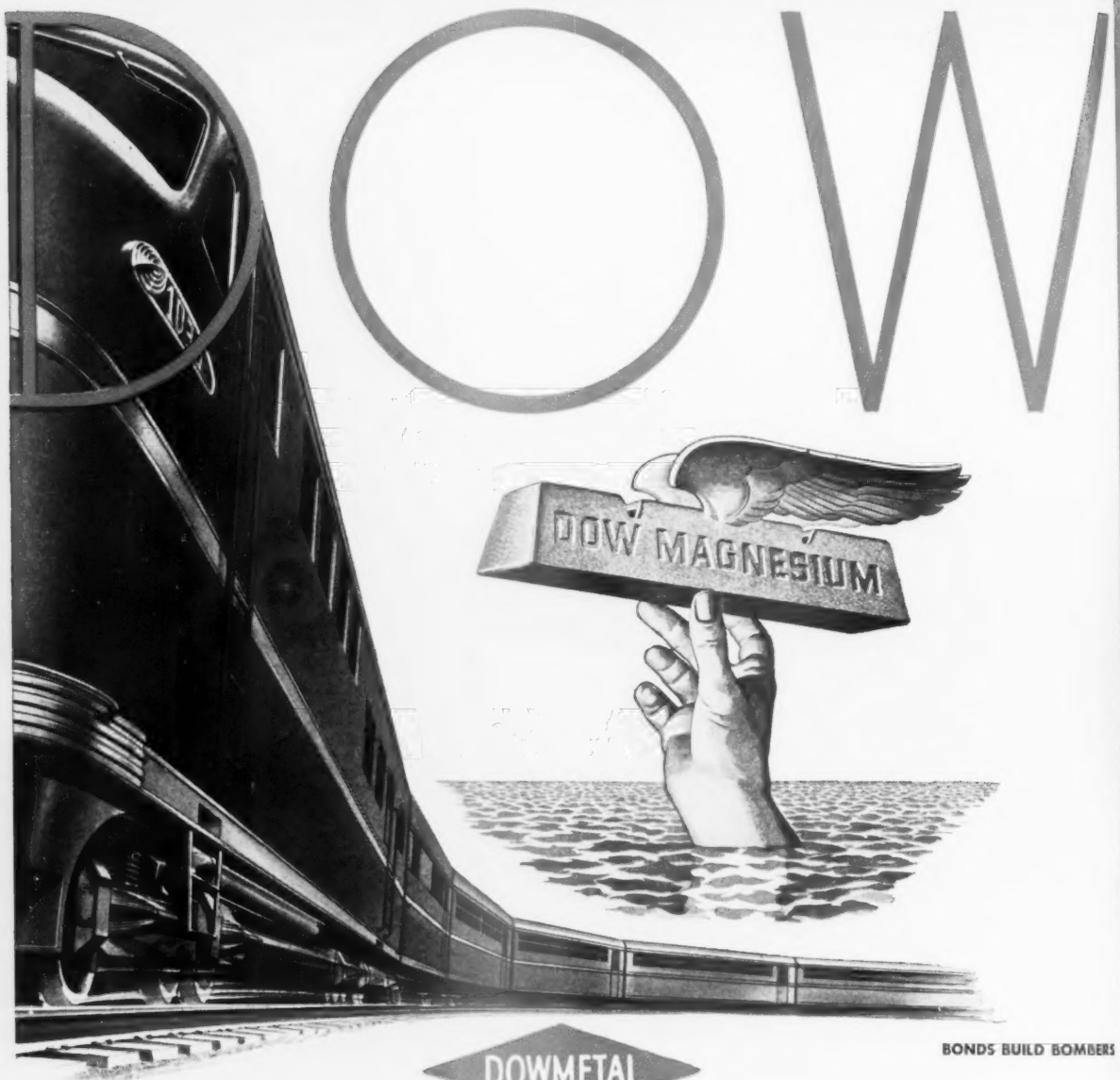

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accompanied by rain. *The Bulletin of the American Meteorological Society*, February, 1943, pages 54–59, 1 illus.

The Weather-Man Wins! Some notes on the activities, organization, and personnel of Canada's meteorologic service. Other data refer to the exchange of information with United States weather stations and the training courses conducted by the meteorologic service for the R.C.A.F. and the R.A.F. The article also includes a brief description of the purpose and operation of the radiosonde, a device for obtaining weather information at varying altitudes by means of a radio transmitter attached to a hydrogen balloon. *Canadian Aviation*, May, 1943, pages 84, 86, 3 illus.

Elementos de Humedad Atmosferica (Elements of Atmospheric Humidity). J. C. Gómez. A compilation is made of formulas pertaining to absolute humidity, relative humidity, and specific humidity. Calculations are also worked out for the mixture of air masses as a function of water vapor, temperature, and atmospheric pressure. *The Bulletin of the American Meteorological Society*, February, 1943, pages 60, 61.

The cargo hold of the Curtiss Caravan is only 36 in. off the ground, thus facilitating rapid loading and unloading of military cargo.

Military Aviation

You Can't Compare Fighters. Ed Yulke. The design and performance characteristics of Allied and enemy fighter planes are discussed. It is explained that a direct comparison of fighter planes cannot be made because the specifications that governed the original basic designs were entirely different. Armament requirements, strength requirements, equipment to be carried at all times, and the performance figures that were to be met depended on what the particular air force thought it needed for the operations in which the planes were to be used in actual service. To show how the various requirements affected the different designs, design criteria are considered point by point. Charts are furnished showing the maximum speed, armament, and optimum fighting altitude of various fighter planes. *Air Trails*, June, 1943, pages 14, 15, 48, 52, 2 illus.

Grasshopper Guerrillas. James L. H. Peck. In this article the writer discusses the use of a large number of low-powered light planes for guerrilla tactics in warfare. A description is given of a demonstration at a Washington airport in which a task force of light planes invaded and captured the airdrome in mock maneuvers. *Air Progress*, June, 1943, pages 30, 31, 70, 71, 4 illus.

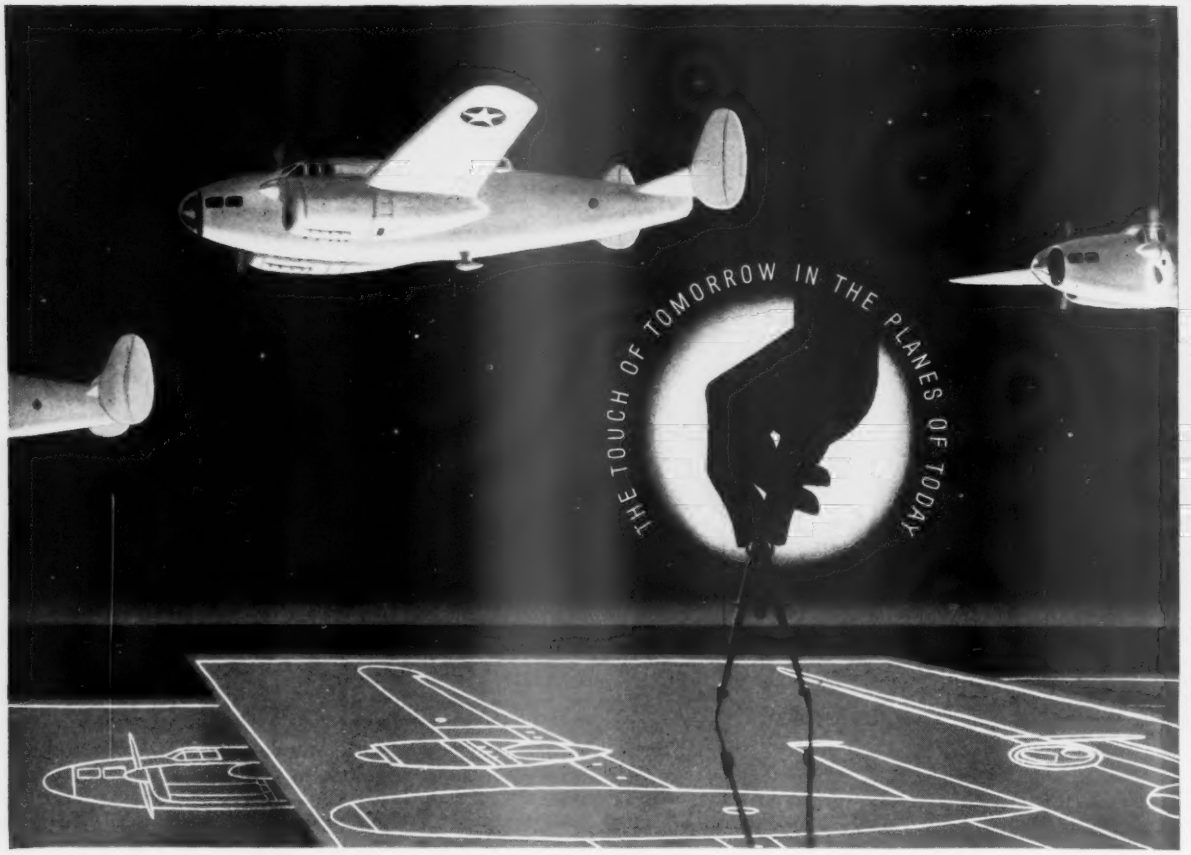
Transport and Bombing. H. J. A. Wilson. To review the reasons why the Allied Air Force spent so much time bombing locomotives, freight trains, and railway installations in Germany and the occupied countries, a survey is made of the German transport position. A map is furnished of Germany and surrounding countries showing the transport system that is so important for maintaining a supply of men and weapons to the battle fronts. A short description is given of the tactics of the Royal Air Force in this field of aerial warfare. *Aeronautics*, June, 1943, pages 28–32, 5 illus.

African Front Line Aircraft Assembly. A brief report of how American aircraft equipment was hauled, uncrated, and assembled on the battle-fronts of North Africa. Native helpers are credited with having assisted greatly in the work. Other aids to field assembly men were the methods by which the parts were packed in the home factories. *Aero Digest*, May, 1943, pages 122–124, 10 illus.

Britain's Air Women on Equal Footing. Activities of the Air Transport Auxiliary, which delivers all aircraft from British factories to the Royal Air Force Maintenance Units and to Commands, are related. The hazards of ferrying aircraft in Britain are divided into four groups: those caused by weather, pilot error, unserviceability of aircraft, and navigational conditions. It is explained that the ferry pilots do not fly unless the weather conforms to two main conditions: there must be at least 2,000 yards of visibility and clouds must not be lower than 800 ft. With these limitations, men and women pilots, who are on precisely the same operational basis, ferry any aircraft to any part of Great Britain. *National Aeronautics*, May, 1943, pages 18, 54, 3 illus.

Has Precision Bombing Failed? William S. Friedman. This is a general discussion of precision bombing operations against the enemy, based on available information and recent developments. The performance of American bombers in Europe is appraised. It is stated that the purpose of the United Nations system of bombing the continent by day as well as by night is to saturate the enemy's defenses. The projected system of keeping the enemy on constant alert requires all kinds of equipment, since no particular technique of attack will answer all purposes at all times. The advantages and disadvantages of daylight bombing raids are explained. Bombing operations at different altitudes are discussed. It is shown that no one type of bomber is suited for all-purpose, round-the-clock operation. Several experts have offered opinions as to what such an all-purpose bomber might look like and their consensus is incorporated in a drawing. *Popular Science*, July, 1943, pages 41–45, 202, 204, 206, 7 illus.

Armoured Aviation. The writer discusses one type of aircraft which may be said to emerge from the principles of assault warfare advocated by General de Gaulle. It is stated that it will be required to fulfill five chief functions: (1) In case of invasion it will break the first onrush of the enemy by low flying attack; (2) it will specialize in cannon assault upon enemy tanks; (3) it will accompany tank units with the object of clearing the way for their advance; (4) it will harass the rearward elements of the enemy forces by disorganizing his communications; (5) it will undertake special reconnaissance, such as low-flying photographic work when the conditions prevent or im-



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pede the normal reconnaissance. The flying requirements of an aircraft designed especially to fulfill these functions are examined. The airplane fulfilling these general requirements is visualized as a low-wing cantilever single-engined monoplane, with a single seat. The proposed specifications for such a plane are listed and discussed. *Aeronautics*, May, 1943, pages 33–35, 4 illus.

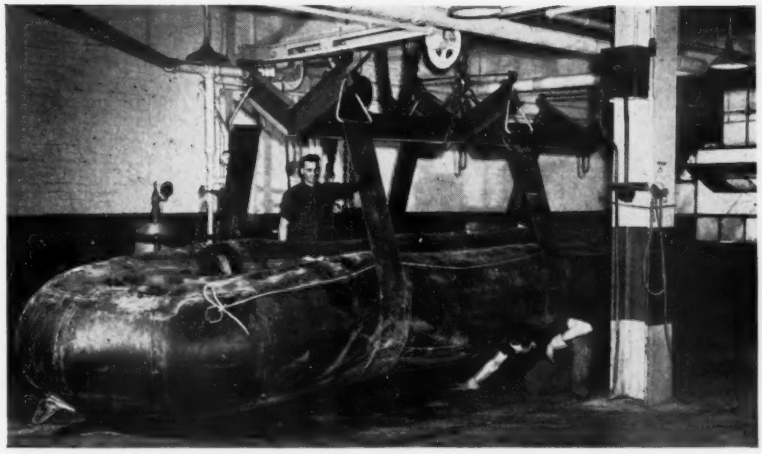
Lone Wolves of the RAF. Jack Alexander. The tactics of intruder planes in destroying enemy bombers over their own base are described. The writer reviews the Royal Air Force origination of the maneuver and its adoption by the Luftwaffe. He also gives the subordinate phases of intruding when, after completing his primary mission, the pilot goes "rhubarbing" until his ammunition is used up. This involves sweeping the countryside at low level and bombing and spraying bullets at sentries, factories, railway trains, barges, and other unplanned targets. Intruder tactics are illustrated by some experiences of one R.A.F. pilot. *The Saturday Evening Post*, June 12, 1943, pages 19, 91, 93, 1 illus.

Naval Aviation

Aerial Mine-Laying. Willy Ley. The use of airplanes for laying mines is discussed. The writer describes how mine-laying squadrons are planting mines that do great damage to enemy coastal shipping. It is explained that the new type of mine layer required a new type of mine. The development of mines for aerial placement is outlined, as well as the results of experience in combating the enemy's mines and devising better methods than the enemy used. *Air Progress*, June, 1943, pages 32, 33, 66, 3 illus.

Water-borne Balloons. N. D. Ryder. This is an article on the men who handle the water-borne barrage balloons along the coasts of Great Britain. It describes their duties, their confinement to the barges with few shore leaves, their relaxations, and their constant vigilance. The personnel of these balloon barges consists of Merchant Navy men, who operate the craft itself, and R.A.F. balloon crews, who also man the Vickers machine guns when enemy aircraft attack the balloons.

In addition to relating how replacements for impaired balloons are made, the article designates the purpose of water-borne barrage balloons. They hinder enemy aircraft from flying at low altitudes and thus prevent them from releasing mines with any great accuracy. *Flight*, April 15, 1943, pages 383–386, 12 illus.



After Navy barges come out of the new vulcanizer that has reduced "curing" time from 3 hours to 50 min. at the B. F. Goodrich plant where they are made, they are inflated for testing and inspection. The barge is deflated to stow away in a small space. When completed, it will be equipped with a steel mounting for an outboard motor.

Jap Seaplane Carriers. Leonard Engel. The Japanese seaplane carrier, a type of vessel not found in many navies, is described, and it is stated that because of the heavy losses of fleet aircraft carriers the Japanese may be forced to bring into action this makeshift type of ship in order to provide themselves with at least a minimum of air cover at sea. The seaplane carrier is to small floatplanes what the "flat top" is to wheeled seagoing aircraft. The writer holds that it cannot compare in effectiveness with the regular carrier, because floatplanes fall short of wheeled planes in performance and fewer planes are carried.

It is stated that at the start of the War Japan had at least eleven seaplane carriers—eight converted merchantmen and three specially built. Two or three appear to have been sunk, but this is not certain. The only other navies in which seaplane carriers have been employed are the French and Italian. *Air Trails*, June, 1943, pages 18, 58, 1 illus.

Parachutes

Ripcord Reminders. Richard Switlik. Advice is given on the proper method of using a parachute when jumping from an airplane. The writer counsels that the popular conception of counting after the jump be forgotten and that the parachute cord be pulled as soon as the jumper is certain he is clear of the plane. He describes features of the Switlik harness, manufactured by the company of which he is a partner, and also explains the action of a parachute when the cord is pulled. *Southern Flight*, May, 1943, pages 20, 40, 2 illus.

Personalities

Russian Air Force Leaders. This article briefly outlines the flying careers of Marshal Alexander Novikov, first Marshal of the Soviet air force, and Mikhail M. Gromov, famous Arctic pilot who now commands a Soviet air force unit. It also mentions Ivan Feodorovitch Petrov, Georgiy F. Baidukov, and Alexander V. Belyakov—other Russian air force generals—and Valery Chkalov, Russian pioneer flyer. *Flight*, April 22, 1943, pages 424, 425, 5 illus.

He Pinned Wings on the World. Frank Cunningham. A biographic article on Donald Douglas. In tracing the events of Douglas' aeronautical career, the history and development of the Douglas Aircraft Company are also given. *Skyways*, June, 1943, pages 20, 21, 56, 58, 60, 11 illus.

Personnel

Four Out of Five Are Women in This Supercharger Plant. Herbert Chase. How the Allis-Chalmers Manufacturing Company is successfully building aircraft-engine superchargers, requiring hundreds of difficult machining operations, with a personnel consisting of 80 per cent women is described. It is stated that women, starting with only two or three weeks of training, are handling almost all operations, including those on complex machines. Some act as forelaadies, grinding tools and setting up jobs; others work in toolrooms and some even in the forge shop. *Wings*, May, 1943, pages 477–480, 6 illus.

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Photography

The Aerial Watch on America's Food. S. R. Winters. The application of aerial photography for helping the United States Department of Agriculture determine the best land for the various crops is related. The article describes the general procedure of aerial mapping and the equipment employed. It then goes on to tell how aerial survey maps are brought into use by the Agricultural Adjustment Administration for assignment of planned national acreage of essential crops. With the cost of aerially mapping the United States' existing crop acreage placed at $15,000,000, it is claimed that this method of surveying represents saving of expense. *Flying*, June, 1943, pages 46, 47, 164, 165, 4 illus.

Plants

Preventing and Extinguishing Magnesium Fires. Harold A. Knight. Because of conflicting reports on the best methods of extinguishing magnesium fires, the writer made a survey of Government bureaus, fire insurance bodies, magnesium producers and consumers, and manufacturers of fire-prevention and extinguishing equipment to obtain further information on the subject. This article covers the results of the study. The standard rules and methods worked out by leading magnesium companies are outlined. Three extinguishers approved by the Bureau of Mines are described, and the requirements of an ideal extinguishing agent are listed. Extinguisher tests were conducted with Dowmetal chips and the significance of the tests is discussed. In giving his final impressions, the writer states that experts still differ on the best extinguisher and best technique for controlling magnesium fires. The Ford Motor Company still uses sand. G-1 powder, which consists principally of powdered graphite with a small percentage of liquid plasticizer, stands high in the estimation of the writer. *Metals and Alloys*, May, 1943, pages 960–966, 6 illus.

Air-Conditioning. Frank H. Slade. The summer and winter air conditioning of manufacturing plants is discussed. It is emphasized that physical fatigue of employees has an important bearing on plant output. The writer explains that the object of air conditioning is to control the heat losses from the human body in such a manner that no physical discomfort is experienced. Air conditions that affect comfort and health are listed. For the purpose of illustration, the writer considers an all-year-round air-conditioning plant that will cool, humidify, cleanse, and circulate the air in summer and warm, humidify, cleanse and circulate the air in winter. The air conditioning of underground factories also is discussed. *Aircraft Production*, May, 1943, pages 236–240, 6 illus.

Plastics and Plywood

Points on Plastics in Aircraft Engineering. Part II. John Sasso. This is the second of a series of articles on the engineering and design of plastic components for aircraft. It is devoted to an examination of the comparative properties of plastic materials. Their weights, tensile strengths, compressive strengths, and impact strengths are studied. The thermal properties, electrical properties, high insulation resistance, and moisture resistance are also considered. The article contains three relative tables: One lists various plastic applications for aircraft parts; another, the thermal properties of different plastic groups; and the third, the electrical properties of these plastic groups. *Aviation*, May, 1943, pages 187, 189, 190, 360, 363, 4 illus.

Plastics in 'Planes. The important role that Canadian plastics are playing in the production of fighting aircraft is described. The plastics industry in Canada was, for the most part, able to meet the demands of the nation's aircraft program for glass and plastic products immediately at the outbreak of war.

To explain how this was accomplished, the writer describes the activities of Duplate Canada Limited, of Oshawa, Ontario, one of the companies engaged in this industry. The manufacture of bullet-proof glass, aircraft fittings, and extruded plastic tubing is discussed. *Air Force Review*, June, 1943, pages 12, 26, 3 illus.

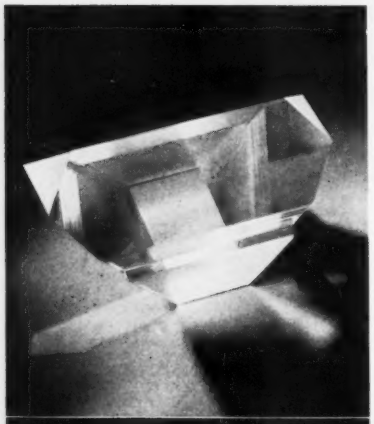
Lumarith's Versatility. Harriet E. Raymond. The aircraft applications of Aero Quality Lumarith are examined, the properties of this cellulose acetate plastic are described, and the operations necessary for forming it into airplane parts are related. While retaining excellent light-transmission qualities, Aero Quality Lumarith excludes the sunburn-producing rays of the sun. Its weathering qualities resist crazing, warping, and buckling. Although Lumarith is claimed to possess great impact strength, simple curves can be cold-formed. Methods of fabricating this material and bending, forming, polishing, mounting, and cleaning it are explained. Advice is also given on how to remove scratches from Lumarith and how to store it. *Southern Flight*, May, 1943, pages 36–38, 10 illus.; "Cellulose Acetate Sheet Plastic Assumes Importance in Aircraft," W. E. Moeller, *Aero Digest*, May, 1943, pages 183, 187, 191, 9 illus.

Plastic Planes. William Winter. The advantages of using plastic-bonded plywood for aircraft construction are surveyed, the bonding process is explained, and the properties of the synthetic resins which provide the bonding agents are described. Various applications for aircraft components are mentioned. Among the advantages cited are: the saving of critical materials; the utilization of new labor supplies; imperviousness to salt water, acids, alkalis, and termites; greater "local strength" than metal; and elimination of splintering. *Flying*, June, 1943, pages 34–36, 175, 7 illus.

Plywood Saves Man-Hours and Critical Materials. Figures are given on the economies in money and time effected by the substitution of plywood for aluminum in the construction of the Canadian Anson II and V. The changes were worked out jointly by Federal Aircraft and the subcontractors, who took advantage of the fact that the strength-to-weight ratio of plywood is superior to that of aluminum. One of the greatest methods of saving was achieved by the substitution of plywood for the fuselage nose. *Canadian Aviation*, pages 93, 94, 8 illus.

Pneumatic Clamping Device for Plywood Skins. A pneumatic system of clamping plywood in position developed by the Morris Motor Company, England, is described. It is stated that the system greatly facilitates the gluing of plywood skin to the wing and tailplane frames of aircraft. A sectional view of one of the pneumatic clamps is furnished and another illustration shows a tailplane with the plywood skin held in place by these clamps while the glued joints are hardening. *Automotive and Aviation Industries*, June 1, 1943, page 29, 2 illus.

Aircraft Plywood and Its Finishing Requirements. Charles A. Carter. The concluding installment of an article on finishes and finishing requirements for aircraft plywood continues the detailed explanation of the characteristics of various materials. The characteristics of No. 808 pigmented plywood sealer are described as a development stemming from the effort to eliminate the need for fillers and



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sanding surfaces. It is used as a spray application, with a vehicle similar to that of the No. 802 clear plywood sealer as a base. When sprayed over No. 802 sealer or over No. 8605-A synthetic plywood filler and after air drying from two to three hours, it can be "scuff-sanded" and receive a subsequent coat of camouflage enamel. Its other features are stated to be a 50 per cent "build," good both for enamels and lacquers, and low specific gravity.

Lusterless camouflage enamel is similarly described as to characteristics and features, and the importance of the thorough sealing of the inner surfaces of wings and tail surfaces is discussed. Methods and sequences of application are described at considerable length and recommendations for the proper technique to be followed in this work are given. *Commercial Aviation*, April, 1943, pages 120, 122.

Official Plywood and Veneer Specifications. Robert C. Perkins. The defects in plywood materials which are not acceptable must be readily recognized, and it is claimed that this is just as important as the determination of the defects that are permitted by the specifications. For these reasons illustrations are provided as a guide in passing or rejecting the more common of such products. Appearance is not, in itself, a completely reliable guide and should not be depended upon entirely, although it is a good indicator. The defects that are not acceptable are explained in considerable detail under headings of (1) brash wood, (2) pronounced compression wood, (3) shakes, (4) compression failures, (5) patching of veneer, (6) decay in any form, and (7) slope of grain.

In a similar manner the acceptable defects are described, also under seven separate headings. The maximum percentage of face and/or inner ply grade veneers needed to meet panel construction requirements are summarized. The allowable distribution of face and inner ply grade aircraft veneers is discussed, as well as combinations of allowable defects and significance of defects on the strength of aircraft-grade veneers. Faults are listed in the order of their seriousness and defects likely to be encountered in each of the species are outlined. Suggestions for applying the so-called "12-in. Square Rule" to veneers narrower than 12 in. are given. *Aero Digest*, May, 1943, pages 273, 274, 277, 279, 284, 14 illus.

Flexible Pressure in Veneer and Plywood Work. Thomas D. Perry. Principles underlying the new curved-plywood manufacturing technique are examined and evaluated, and some of the more important methods that have contributed to rapid progress in this field are outlined. Discussing methods of gluing sheets of veneer to plywood, the writer contrasts the method of applying one-directional pressure through rigid plates with recent developments in applying flexible pressure with a fluid medium such as steam, hot water, or compressed air. Three methods of making monocoque plywood with flexible pressure bags are outlined. It is concluded that monocoque and semimonocoque plywood made by omnidirectional pressure is proving its adaptability in many aircraft and boat designs. *Mechanical Engineering*, June, 1943, pages 417–424, 11 illus.

Postwar Aviation

Noble Lords and Ancient Mariners. Djinn. The writer scoffs at a proposal made in the House of Lords that shipping companies be given control of British postwar civil air transport. He points out that air transport problems are highly specialized ones that differ in many ways from those of oceanic transport. He also claims that those people who have been conducting air transport for the past 20-odd years have done an extremely

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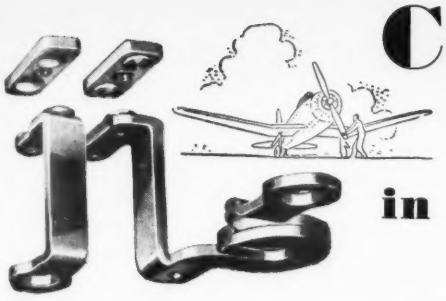

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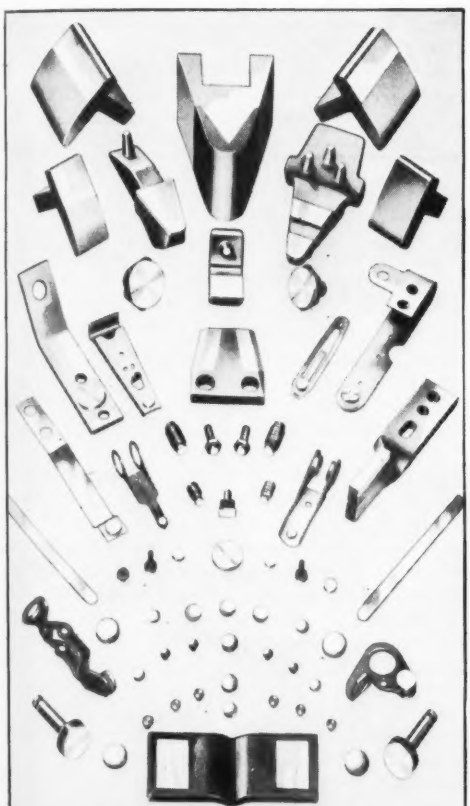
When time spurs on necessity, cooperation does a mighty job in achieving the seemingly impossible. And Mallory contact engineers have been able to cooperate with a wealth of experience and knowledge to speed solutions of tricky problems.

Aircraft starting relays presented one of the trickiest. Recently Mallory was called in to test materials and set contact assembly specifications for a new airplane starting relay. It was a super-hurry job.



This relay had to handle normal loads of 250 to 300 amps and overloads of 1000 amps or more. Checking requirements against Mallory-developed contact metals, our engineers found that the application indicated current carrying contacts of Mallory coin silver—an alloy widely used as a substitute for fine or sterling silver. It is notable for maintaining a relatively low contact resistance and is harder than fine silver.

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adequate job, while the shipping companies on the other hand have failed to equal either the organization or the service of the air lines. *The Aeroplane*, April 9, 1943, pages 416, 417, 2 illus.; "Operators of Air Transport," Sir Alan Cobham, *The Aeroplane*, April 16, 1943, pages 445, 446, 2 illus.

Canada First Country Announcing After War Air Policy. The Canadian Prime Minister's announcement of Canada's postwar air policy is recorded in full. His statement covers four points with respect to domestic aviation and five with respect to international aviation. In conclusion, the Canadian government's policy on air transport is summed up as follows: (a) The government sees no good reason for changing its policy that Trans-Canada Air Lines is the sole Canadian agency which may operate international air services. (b) Within Canada, Trans-Canada Air Lines will continue to operate all transcontinental systems and such other services of a mainline character as may from time to time be designated by the government. Competition between air services over the same route will not be permitted, whether between publicly owned service and a privately owned service or between two privately owned services. There will remain a large field for the development of air transport in which private Canadian companies may participate, and, while preventing duplication of services, the government will continue to encourage private companies to develop services as traffic possibilities may indicate. (c) In order to prepare for forthcoming international negotiations on air transport, the government is studying carefully the problems that will have to be dealt with in the negotiations. (d) The Canadian government strongly favors a policy of international collaboration and cooperation in air transport and is prepared to support in international negotiations whatever international air transport policy can be demonstrated as being best calculated to serve not only the immediate national interests of Canada but also the overriding interest in the establishment of an international order that will prevent the outbreak of another world war. *Canadian Aviation*, May, 1943, pages 76, 78.

Shipowners and Air Transport. R. H. Thornton. Following two previous articles that censured a proposal that shipping companies operate British air transport routes after the war, this article takes up the case for the shipowners. Written by a director of a British shipping firm, it is an interpretation of the shipowners' attitude toward air transport. The writer stresses administration as the most important factor in running air routes and accuses Imperial Airways of having failed in questions of vision, policy, and leadership. He argues against government subsidy for air transport and protests its operation by a "national monopoly."

In opposition to the first two articles, this one lauds the record of shipping company management and criticizes operation of air lines by the existing Airways Corporation. The writer denies any attempt at "control" of British air transport on the part of the shipping companies but states that, if they were allowed to enter the field, they could add some useful and progressive contributions to the future of British air commerce. *The Aeroplane*, April 30, 1943, pages 502, 503, 3 illus.

The Postwar Small Airplane and How to Increase Its Utility. Peter Altman. To take advantage of the vast store of flying experience that will be available after the war, the writer states that it will be necessary to put the operation of aircraft on a firmer basis by increasing the utility of aircraft. As a solution to this problem he offers a plan for combining the use of civil airplanes with existing methods of travel. The operation of the plan makes use of a combination of Fly-A-Plane Service with existing or newly organized Rent-A-Car Service. The proposed Fly-A-Plane-Car Service is described. To make a trip by air, the prospective traveler calls for an airplane for a given destination and at the same time reserves a car at the destination. If the weather is good, the trip is completed by air and the local calls at the destination are made by car, which is ready when the airplane arrives. Should the weather prevent flying, the trip can be made by car to a point along the road where flying is satisfactory, and the remainder of the distance can be traveled by airplane. Likewise, if the trip is started by air but has to be discontinued along the road, a long layover is not necessary, because the trip can be continued by car to a point where flying can be resumed or direct to the destination.

Statistical support for the plan is developed by studies of the number of airplanes available, the number of operators, their geographic distribution, and cost factors affecting the problem. Charts aid in the visualization of the figures. *Automotive and Aviation Industries*, May 15, 1943, pages 17–21, 84, 86, 10 illus.

Production

Mosquitos Are Bad This Year, Adolph! Wings "by Massey-Harris." Imperial Rattan Turn Out Wing Rear Spar. Wing Front Spar Built by Kroehler. In these four articles details are presented on the production of the Mosquito in Canadian plants. The first article surveys design, structural, and production features of this wood-constructed fighter bomber. It includes a full description of the plane, as well as data on how the main assembly processes are performed by the de Havilland Aircraft of Canada, Ltd.

The second article deals with the building of Mosquito wings. It relates operating procedures at the Massey-Harris Company, prime wing-assembly contractor, and also explains the construction of the wing itself. Of conventional two-spar box section with a pronounced forward sweep to its rear spar, the Mosquito wing is made of wood of various types and Bakelite. The only metal used is for small aluminum-alloy and steel fittings and various controls, cables, etc. An inner and outer shell with stringers between are a feature of the wing's top skin. The wing is built in a main wing assembly jig where front and rear spars, interspar ribs, bottom skin and inner shell with stringers are attached, followed by the attachment of the outer shell. Subcontractors supply such components as the front spar, rear spar, interspar ribs, leading edge, shrouds, tank doors, wing tips, ailerons, and flaps.

How rear spars are produced by the subcontracting firm of Imperial Rattan Company is the subject of the third article. In detailing the manufacturing procedures of this component, the article indicates how the skill of former furniture manufacturers was applied to aircraft construction. Data on the production of the front spars are covered in the fourth article. Methods related are those used at the Kroehler Manufacturing Company. *Canadian Aviation*, May, 1943, pages 47–60, 35 illus.; "The DeHavilland Mosquito Bomber and Fighter," *The Engineer*, May 7, 1943, pages 373–375, 6 illus.; "'Mosquito' Design Facilitates Production," James Montagnes, *Aviation*, May, 1943, pages 259, 261, 7 illus.

North American P-51 Mustang. How the North American Mustang was built from information gained from the battlefield is related. It is explained that six months after the war had begun the British Purchasing Commission called on North American Aviation for the mass production of a single-seater fighter already in exis-

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So to the pilot on the fighting front, the sum of all this is the beauty of performance—the dependable, unfailing action so vital to his mission and his safe return.

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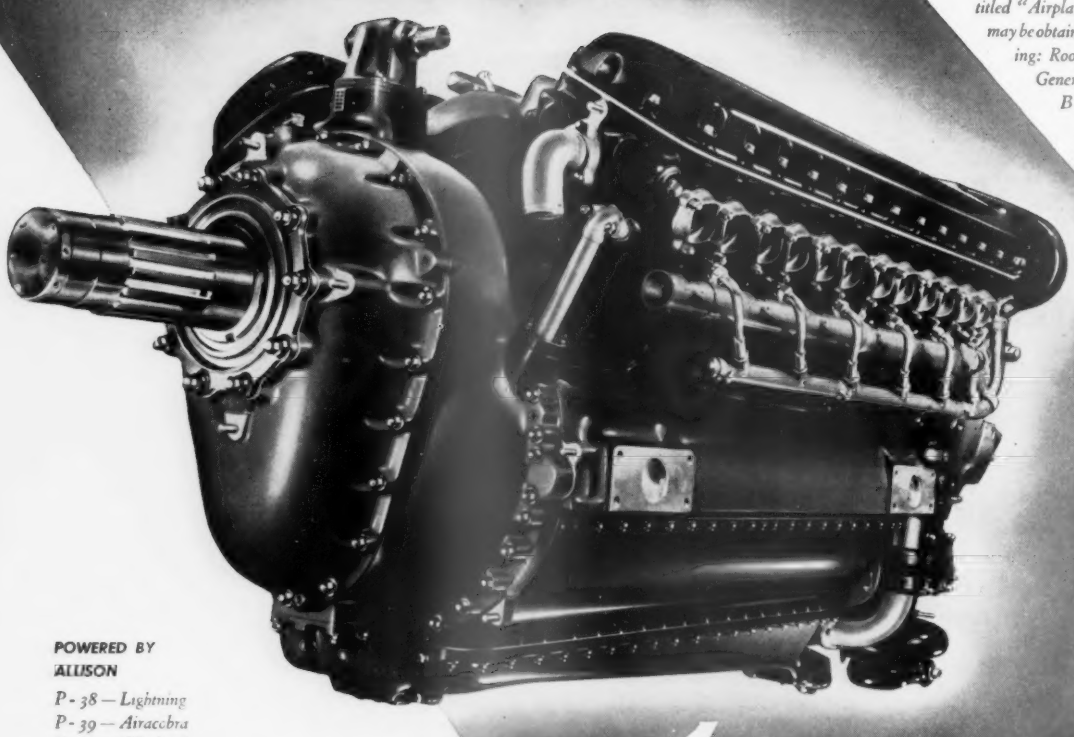

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tence. North American's counter proposal was a new design incorporating advanced features of design. How the proposal was accepted and the plane built in 120 days is described. The increased cruising and top-speed requirements involved the solution of engineering problems connected with shock wave phenomena. The final development was a slim-line, low-wing monoplane with a wing span of about 37 ft. equipped with 1,150-hp. Allison engine and Curtiss constant-speed propeller. Features of the plane and its performance are outlined. Production operations are illustrated. *Air Tech*, May, 1943, pages 18–23, 68, 11 illus.

Aircraft Sheet-Metal Work. Wilfred E. Goff. The production of sheet metal equipment for Bristol engines is described. Manifolds, cowlings, and other sheet metal parts are manufactured in a special factory. The equipment fitted to the Hercules double-row sleeve-valve engine is illustrated and described. It embodies a combined exhaust manifold and ring cowling, detachable panels for the engine itself, cabin-heating equipment, and a flame-damping unit and anti-glow panels and cuffs for the exhaust system. Various steps in the production of this equipment are discussed. The use of soft metal forming tools and spot-welded units is described. *Aircraft Production*, May, 1943, pages 219–239, 32 illus.

Formed Tubing in Aircraft. J. P. Boore. A survey of the many special shapes that can be rough-formed from seamless steel tubing prior to machining. While the article does not undertake to define all the limitations or possibilities of formed tubing, it indicates the potentialities in the use of rough-formed tubing for machine parts and the savings that can be effected in material and machining time. The most common types of forming likely to be applicable in aircraft production are illustrated and named in illustrations accompanying the article. *Western Flying*, May, 1943, pages 66, 68, 15 illus.

Reduction of Man-Hours in Aircraft Production. I. M. Laddon. Specific methods by which Consolidated Vultee Aircraft Corporation have reduced the number of man-hours per plane produced through increased fabricating efficiency are given. It is shown how the establishment of mechanized lines and a coordinated flow of raw materials through fabrication processes into subassembly lines, followed by the flow of subassemblies into the final assembly line, eliminated wasted man-hours and solved such problems as that of parts storage. The turning of

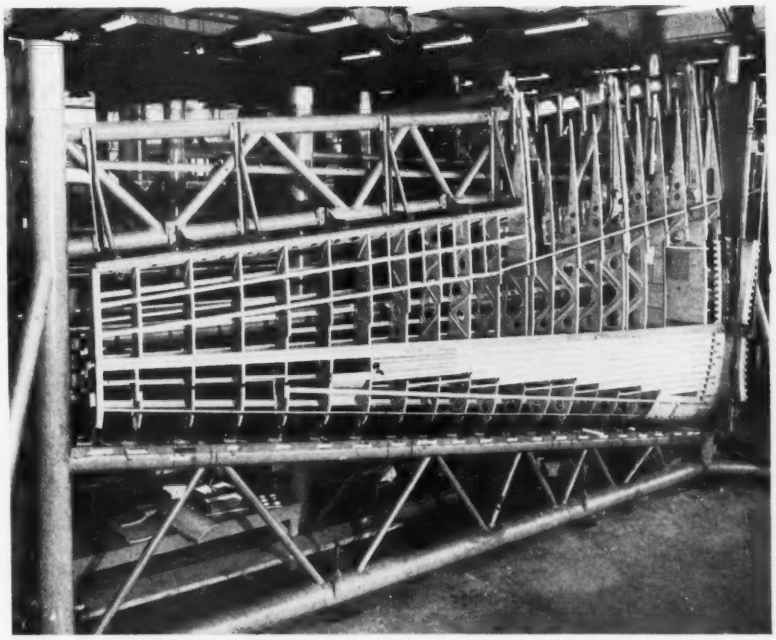


Illustration of a Model 37 major steel assembly jig for outer wing panel at Vega Aircraft Corporation. (*See* "Aircraft Tool Planning. Part II." Page 89.)

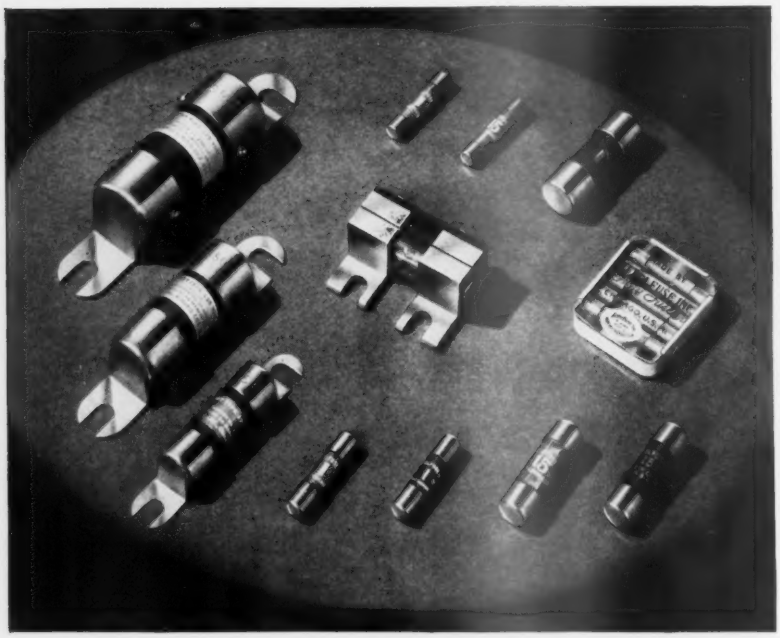
planes to a 45° angle on the final assembly line, the inauguration of predetermined operating department controls, the institution of the supervisory Cost Improvement Proposal Plan, and the Employee Suggestion System are innovations reported to have effected additional economies in man-hours. Other ways listed are: (1) Long, complicated assembly operations that formerly had to be done by craftsmen who required several years of apprenticeship are broken down into small subassemblies that can be accomplished by "green" hands, including women totally inexperienced in any kind of factory procedure; (2) increase in skill in tooling design methods, which has resulted in better tooling; (3) better assembly fixtures developed over a period from the time the first Liberator came off the line up to the present time; (4) better installation fixtures developed over the same period of time. *Aviation*, May, 1943, pages 170–173, 356, 357, 6 illus.

Fluid Production. Allan Lee. An account of how Eastern Aircraft Division of General Motors was converted from a group of automotive plants to an aircraft manufacturing group. Changes in methods, tooling, and equipment are commented upon and automotive mass production and the so-called fluid production required for airplanes are compared. *Air-Age*, August, 1943, pages 20, 21, 64, 8 illus.

The American Scene. Sir A. H. Roy Fedden. These are the reported impressions of the leader of the British aircraft mission to the United States. The objects of the mission were: first, to have British aeronautical engineers examine American production in detail and ascertain if anything could be learned which would help speed British aircraft output; second, to have the members of the mission confer with American authorities on a number of technical problems which required urgent attention.

The writer reviews the expansion of the American aircraft industry and indicates its present scope. Stating that there is a number of new American manufacturing procedures which can be introduced into current British production, he gives a few typical examples. These include certain special-purpose machine tools, methods of quenching and straightening hardened components, engine packing, and the Packard system of stripping and rebuilding Rolls-Royce engines on a continuously moving conveyer. Other comments pertain to new stressed-skin technique, new aircraft types, and engine development. Particular emphasis is placed upon the extensive educational and research facilities provided for training and development in the United States. *Aircraft Production*, May, 1943, pages 244–246.

Chevrolet's Unique Setup for Airplane Engine Production. Joseph Geschelin. How the change-over from peacetime to war production was accomplished at Chevrolet's Buffalo plants, which are now producing



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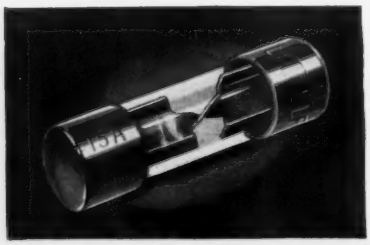

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LITTELFUSES USE A MECHANICAL PRINCIPLE THAT ADDS GREATLY TO VIBRATION LIFE. THIS IS MECHANICAL DEPOLARIZATION, EFFECTED BY TWISTING ELEMENT AT 90° RENDERING IT UNRESPONSIVE TO VIBRATION IN ANY PLANE.

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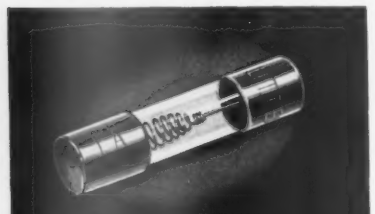

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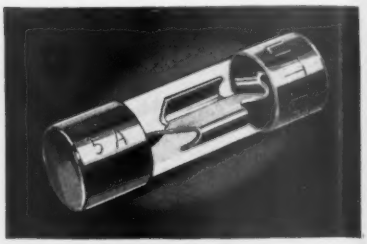

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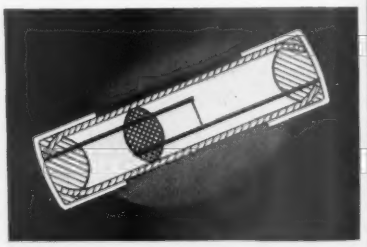

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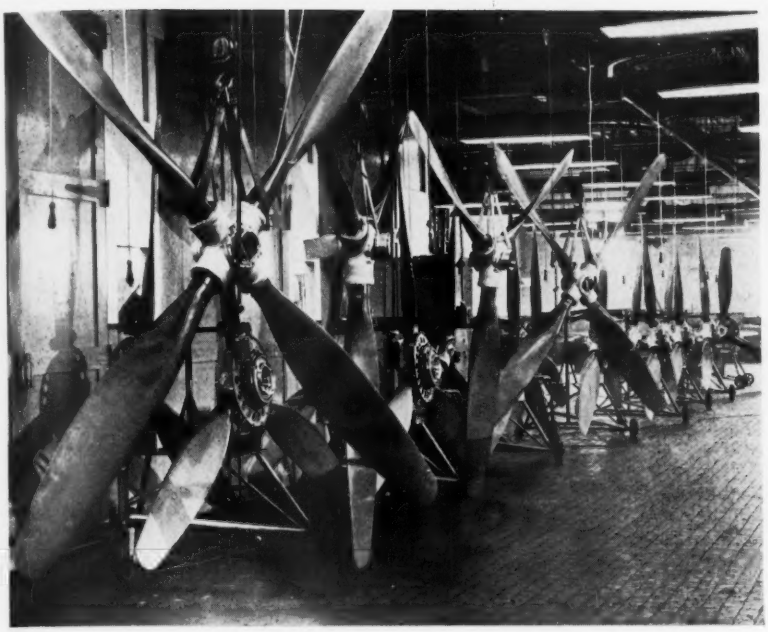


Propellers on the final assembly line at Aeroproducts Division, General Motors Corporation.

Pratt & Whitney aircraft engines, is described. Two of the three plants now on war production represented Chevrolet's branch plant establishment in northern New York State, one being a body and car assembly unit and the other a new engine and axle division. The third unit is a new building designed exclusively for the assembly and testing of completed Pratt & Whitney engines.

Each of the three plants is discussed separately, consideration first being given to the conversion of the Fisher body unit which has been equipped for the production of gears. The engine and axle plant was completely dismantled and outfitted with new equipment for radial engine manufacture, and the machines and processes are described. Assembly and testing operations at the third plant are outlined. *Automotive and Aviation Industries*, June 1, 1943, pages 24–28, 42, 15 illus.

Dry Lubrication. New applications of colloidal graphite in the aircraft industry are discussed. Methods of forming self-lubricating faces on working parts of equipment to enable them to run-in more speedily are described. It is noted that colloidal graphite dispersed in acetone is being employed in the aircraft industry to form slippery surfaces on fabric plastic bearings and bushes. The methods by which dry lubricating films are being formed on components in Great Britain are outlined. *Aircraft Production*, May, 1943, pages 247, 248, 3 illus.

Preview Sketches Cut Tool-Planning Time. Chester S. Ricker. A description is given of how Boeing has developed a system of tooling illustration for speeding up development shops at its Wichita plant. It is explained that with this method tool drawings and detail engineering costs are eliminated if the design is later changed or rejected. *Wings*, May, 1943, page 481, 1 illus.

Present-Day Manufacturing Problems of the Aircraft Industry. C. W. Perelle. One of the vice-presidents of Consolidated Vultee Aircraft Corporation summarizes the nine major production problems that face the aircraft industry today and tells how each problem is being solved. His discussion covers (1) design of the aircraft, (2) tooling and methods, (3) volume of airplanes produced, (4) changes made on these airplanes in the course of production, (5) plant layout, (6) material handling, (7) subcontracting of components, (8) personnel, and (9) scheduling. *Aero Digest*, May, 1943, pages 158, 340–347, 1 illus.

Douglas Subcontracting System. Frederic W. Conant. Methods of subcontracting developed by the Douglas Aircraft Company, Inc., and the part this company has taken in the pooling of production facilities for the war effort are described. The enormous war production task assigned to Douglas is outlined. In little more than two years, five large plants and 15 smaller plants have been built and placed in operation and the company's two original plants were greatly expanded. A dozen different airplane models are now coming out of these plants. An overseas project is functioning successfully despite great obstacles, and the army of Douglas workers has grown to nearly ten times the original number.

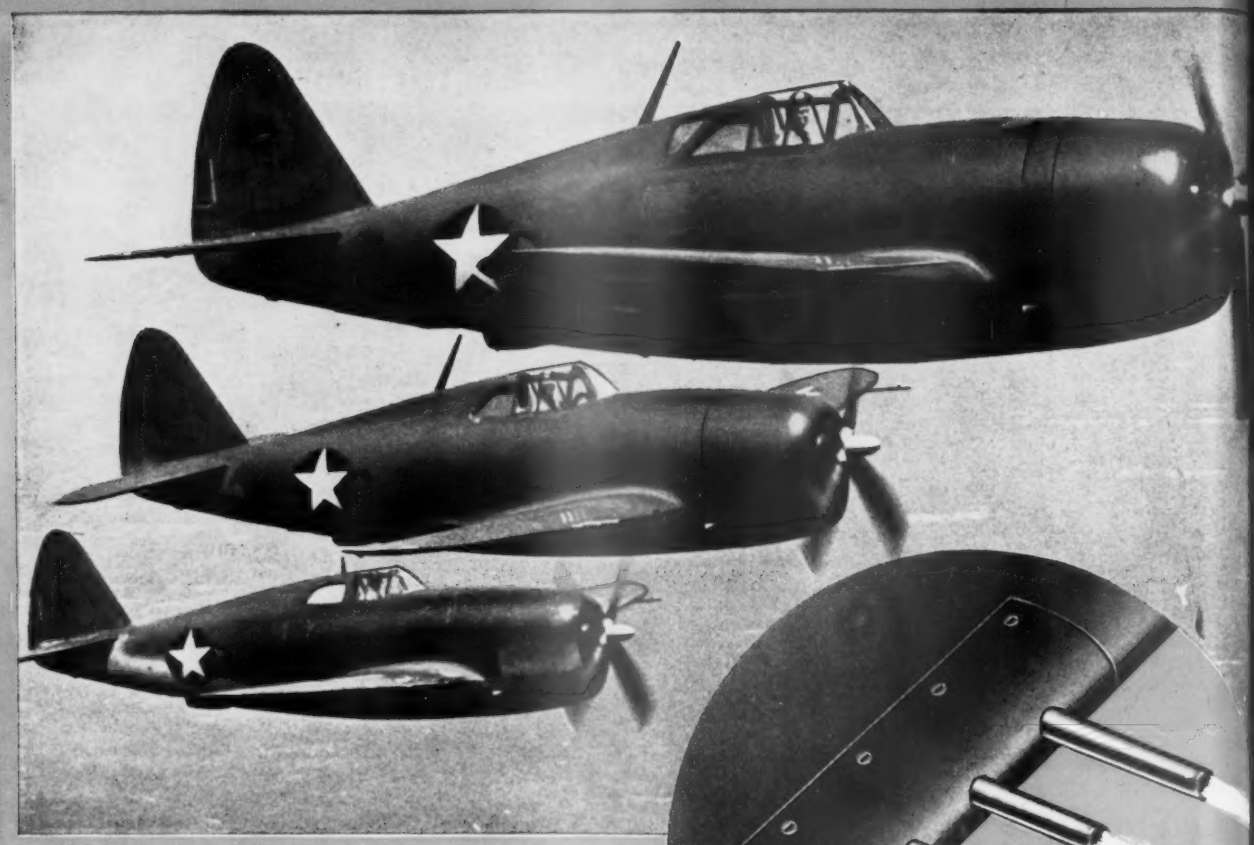
The types of subcontracts awarded by Douglas are given. These include major subcontracts or major portions of the airplane; minor subcontracting items, which comprise subassemblies for installation in major structural units; detailed parts and subassemblies; and nonair-borne products such as tools and fixtures. The scope of the subcontracting is discussed. Charts show the expansion of Douglas manufacturing facilities and plant locations, the warplane models in production at Douglas plants, subcontractors and suppliers, and a typical subcontracting setup for warplane production. *Automotive and Aviation Industries*, June 1, 1943, pages 32, 33, 135, 136, 3 illus.

The Uses and Advantages of Drop Stamps Used in Conjunction with Soft Metal Tools. A. T. Pierce. The most urgent problem that has confronted the British aircraft manufacturers during the past few years has been the economical production of sheet metal parts of complicated form. The performance of air-cooled drop stamps has aroused the interest of many British firms, and in many cases the production capabilities have exceeded all expectations.

Air-cooled machines are stated to have two main advantages: (1) All operations can be easily controlled; (2) the sensitivity of the mechanism enables the operator, without fatigue, to move the ram rapidly and with as much pressure as the work requires, at the same time keeping the work under visual supervision. This lightweight control contributes largely to the accuracy of the product and consequently to the output obtainable.

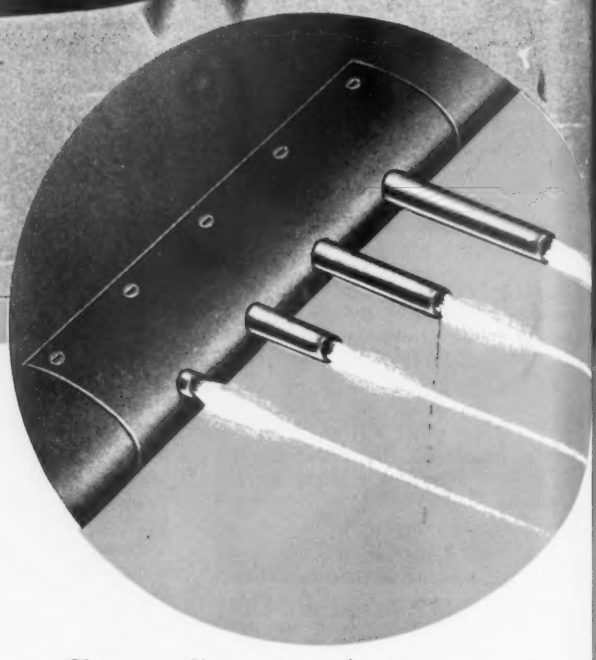
The life of soft metal tools is discussed. It is explained that with a correctly designed tool, a suitable metal specification, and proper use on the machine, the life of the tool and the number of the pressings produced are indefinite. Some production figures on parts are given, and the order of operations from the tool design to the finished pressings is outlined. *Sheet Metal Industries*, May, 1943, pages 831–835, 9 illus.

Bulletins to Many Plants Help Put Production Improvements to Work. J. J. Lee. The writer gives a description of how the Curtiss Airplane Division is organized to gather and disseminate information on new methods and manufacturing short cuts and to enforce standard tooling throughout its factories. Samples of

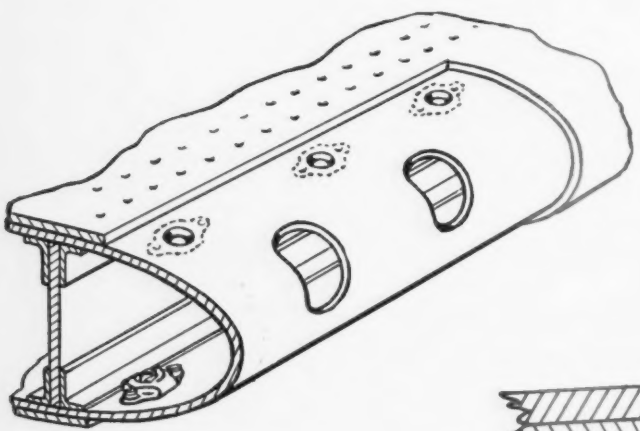


THE REPUBLIC P-47

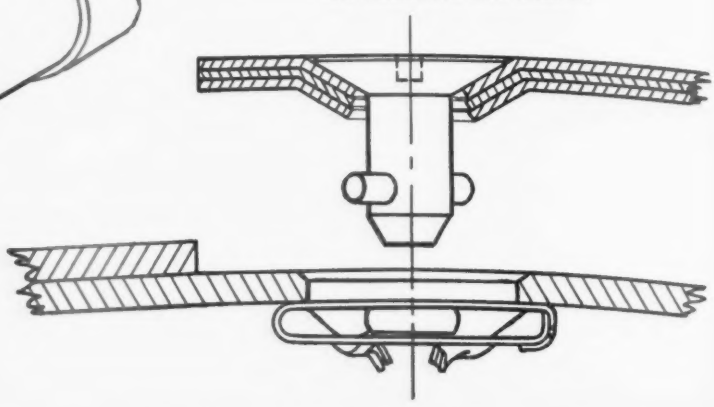
Republic Aviation Corporation has selected Shakeproof Cowl Fasteners for the important job of locking the gun covers on the wing assemblies of their "Thunderbolt" fighter, the famous P-47.



Close-up illustration of wing gun cover locked with Shakeproof Cowl Fasteners. Note that the slots of the stud heads are in alignment, which is visual indication that all fasteners are closed.



Cutaway of wing structure showing Cowl Fastener spring unit applied to inner sheet.



Detail of assembly showing stud inserted in outer sheet and spring unit attached to inner sheet.

DESIGNED FOR *Tough Duty!*

Gun Cover Fastenings must withstand severe vibration and impact . . . frequent opening and closing! For such applications specify

SHAKEPROOF COWL FASTENERS

The exceptional efficiency of this fastener is due to its unique design, which provides many important structural advantages as well as quick, positive operation. Its reinforcing base actually strengthens the adjacent structure.

The base is formed to fit the contours of the upper bridge, which provides continuous support and a positive limit to deflection. Wherever a strong, dependable, quick-opening lock is required, use Shakeproof Cowl Fasteners.

ONLY 3 PARTS TO ASSEMBLE!

SPRING UNIT — CROSS PIN — STUD

Fast, easy assembly is assured. Only three parts and only one special tool (pliers for inserting cross pin) required.

AVIATION DIVISION

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Side view of mounted spring unit cut away to show how base is formed to provide continuous support to bridge and a positive limit to deflection.

Plexiglas AND Crystalite

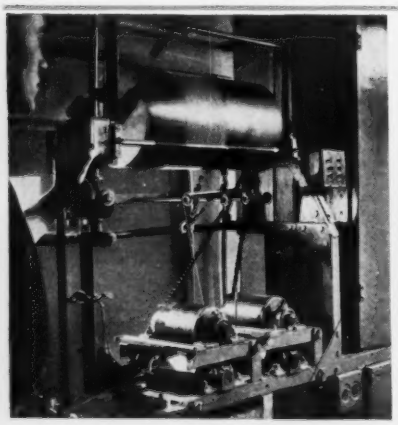
ARE ONLY TWO OF MANY PRODUCTS OF ROHM & HAAS RESEARCH THAT WORK FOR INDUSTRY IN PEACE AND WAR

IN the aircraft and plastics industries Rohm & Haas Company is best known for its development of PLEXIGLAS and CRYSTALITE.

This Company through research has expanded into many other fields of industry. This page shows a few typical examples.

CRYSTAL-CLEAR ACRYLICS are stronger, lighter and more transparent than glass. This type of plastic was first investigated in Rohm & Haas laboratories, first brought into commercial production in our plants. Known as PLEXIGLAS, it forms noses, tail assemblies, cockpit covers, gun turrets aboard every type of Army and Navy airplane.

ON THE ARMY'S sturdy trucks and jeeps, lenses made of CRYSTALITE compression and injection molding powders are proving their rugged dependability. Mounted in the head and tail lights, used to guide a black-out column, these acrylic plastic moldings are extremely strong and their clarity is permanent. Breakage is negligible.



MODERN FAST TEXTILE COLORS presented a need for reducing agents. Rohm & Haas LYKOPON was the first to fill this need. Among our many other developments are RHONITE finishes that make fabrics "crushproof". This yarn slasher is typical of equipment in our textile laboratories which permits close approximation of mill results.

LETHANE 60 WAS DEVELOPED for use in agricultural dusts and sprays. Wide commercial use of this synthetic insecticide has demonstrated that replacing 50% of the rotenone or pyrethrum in dusts and sprays with LETHANE 60 not only stretches this country's limited supplies of botanical toxicants, but actually makes better products.

THE ROHM & HAAS COMPANY developed the first synthetic bate for leather. Today, this bate, under the name OROPON, is in common use in every country of the world. Later developments include synthetic tanning materials to produce great amounts of high quality white leather and finishes producing flexible and washable leathers.

PLEXIGLAS, CRYSTALITE, LYKOPON, RHONITE, LETHANE and OROPON *are trade-marks, Reg. U. S. Pat. Off*

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries

production improvement bulletins and manufacturing development letters are illustrated. *Wings*, May, 1943, pages 488–490, 6 illus.

Engraving for the Aircraft Industry. This article gives a description of engineering methods used by a British specialist firm that is engaged in engraving various parts for the aircraft industry. *Aircraft Production*, May, 1943, pages 249–251, 8 illus.

Impression-Cast Jaws for Aircraft Fittings. H. F. Lenz. Describing how jaws to hold parts for machining operations are now manufactured from a zinc-base alloy known as kirksite "A," the writer demonstrates the advantages of the new type jaw and indicates the improvements it has caused in the machining of forgings. The chief value of the method is said to lie in its adaptation to the various types of clamping fixtures, chucks, oversize collets, and vises. It is claimed that this procedure of making jaws has effected an economy of many man-hours and that the jaws themselves produce superior work because they require neither shimming nor adjusting, can be mounted quickly, and may be relied on for from 8,000 to 10,000 operations without loss of accuracy. *Aero Digest*, May, 1943, pages 269, 270, 295, 11 illus.

One of the most important operations in the manufacture of hollow steel blades for Curtiss electric propellers is the heat-treatment. This picture, taken at the Caldwell, N.J., propeller plant of the Curtiss-Wright Corporation, shows a series of blades being removed from the draw furnace, the final step in the heat-treat process. When the blades leave this electrically controlled furnace they are ready for many precision operations that must be completed before they are ready for use on the fighting planes of the United Nations.

Propellers

Opposite Propeller Rotation. . . Shall It Be Inboard or Outboard? Jean H. Hamelet. A discussion of the question whether propellers should rotate inboard or outboard in opposite propeller rotation for aircraft. Designating the governing factors in any decision on the problem as production and maintenance costs balanced against advantages of performance, the writer examines the effects of rotation on single-engined planes, multiengined planes, and flying boats to determine which type of rotation is most efficient in each case. His conclusions are: (1) If everything else is sacrificed to pure speed, outboard rotating propellers could be the choice, on condition that the tail of the plane be designed accordingly. A poor performance on one engine is to be expected, and it may offset the extra speed. (2) If a safe airplane is wanted—one that is easy to maneuver even on one engine only—inboard rotating propellers are indicated. (3) In the particular case of the flying boat, inboard rotating propellers should be used. . . .if not used because of aerodynamic reasons, at least because of hydrodynamic considerations. Inboard rotating propellers afford a good performance on one engine (which is highly desirable for an ocean-going, twin-engined flying boat) and also a good performance on the water, particularly during the critical take-off period.

The article also includes a brief review of comparable propeller-rotating problems in twin-engined ocean warplanes. *Aviation*, May, 1943, pages 156, 161, 393, 7 illus.

Arc Welding in the Manufacture of Aircraft Propeller Blades. Dr. Elek K. Benedek. The efficient transmission of high power, such as 2,000 hp. per propeller, sets up new theoretic, as well as practical, requirements for propeller design. After describing the shortcomings in conventional propeller design, the writer suggests a simplified and improved design of welded structure which, he states, is more suitable for production and control and eliminates certain defects and vibrations. Sections of the article cover the welded steel propeller with hollow shank and knife-edge blade, the welded steel propeller blade of the rigid skin and reinforced structural steel type, and the welded steel blade of the elastic skin and complete structural steel body type. *The Welding Journal*, May, 1943, pages 335–338, 13 illus.

Saving Damaged Airscrews. The R.A.F. process for salvaging and repairing damaged propellers is outlined. The coordination of propeller field service units with stations for major repairs, the discarding of obsolete methods, and the adoption of more efficient ideas are said to result in repair work along quantity production lines. The article notes the importance of the preliminary inspection that diagnoses the nature of the damage to the propeller and the efficient packing methods that prevent additional damage when the propeller is being returned for repairs. General definition of propeller damage is divided into five classifications: (1) entire propeller requires stripping; (2) impairment of blades only; (3) damage by fire; (4) slight damage, repairable without stripping; (5) investigation required. *The Aeroplane*, April 9, 1943, pages 420, 421, 6 illus.

Radio

Voice of the Plane. Lt. Myron Eddy. The writer explains the basic principles on which aircraft transmitters operate and describes the standard types of transmitters used on transport planes. Circuit diagrams are provided to clarify the descriptions. *Air Tech*, May, 1943, pages 39–41, 44, 8 illus.

Radar, the Supersleuth. Donald Wilhelm. A simplified explanation of Radar, the radio system for detecting planes in flight. The system is based upon the continuous sending of high-frequency radio waves. When these Radar waves strike a ship or plane they are reflected back and

HIGH-ALTITUDE ASSIGNMENT

To meet the severe requirements of high-altitude flying, Packard Electric has developed a special high-tension aircraft cable with a tough synthetic rubber sheath protecting inner-braided insulation.

This Packard cable has been adopted by the Army Air Forces for planes which operate "close to the ceiling." It is qualified for the job by exceptional resistance to extreme heat, cold and corona, as well as to such common destructive agents as abrasion, moisture and age.

Packard research and experience are applied in full measure to aircraft cable developments. Among other important improvements pioneered by Packard is the extrusion of plastic compounds on low-tension aircraft cable, eliminating the use of critical rubber and improving insulation characteristics. Packard Electric Division, General Motors Corporation, Warren, Ohio.

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AIRCRAFT IGNITION CABLE

ARMY E NAVY

PACKARD CABLE SERVES THE ARMED FORCES on trucks • jeeps • tanks • armored cars • planes • aircraft instruments • anti-aircraft gun controls • landing boats • radio equipment.

picked up by receiving apparatus. It is stated that the waves are unaffected by fog, smoke, rain, or snow. The Radar method of radio detection was first used by the Americans and British but has been imitated now by the Germans, Italians, and Japanese. The importance and advantages of Radar are demonstrated in the article. *Collier's*, May 22, 1943, page 16, 1 illus.

Stress Analysis

Significance of the Secant and Tangent Moduli of Elasticity in Structural Design. Don S. Wolford. This paper deals with the problem of designing beams and columns of structural materials that have no well-defined yield point and which must be used above their proportional limits to be useful.

Other investigators have demonstrated that analysis of such structures can be made by means of the concept of the reduced modulus of elasticity. The reduced moduli for beams and columns of solid rectangular sections have been developed and checked experimentally. The writer develops formulas for determining reduced moduli of hollow sections and shows that columns can be properly designed by direct use of tangent moduli in Euler's formula. Confirmatory tests were made on columns of corrugated stainless steel. The directional properties of these stainless-steel columns are shown by the experimental data to have a relatively small effect on the column performance. Likewise, stress-relieving for general improvement of physical properties did not appear to produce commensurate load-bearing capacity in these columns.

It is shown that the reduced modulus for beams of hollow section is substantially equal to the secant modulus. *Journal of the Aeronautical Sciences*, June, 1943, pages 169–179, 23 illus.

Electrical Measurement of Stresses. A. Theis. The writer describes a method of measuring stress deformations of the order of 1.0001 to 0.002 by the corresponding variations in electrical resistance in strip gauges, thus enabling the stresses in the material to be determined from the surface deformations, even in the case of rapidly alternating loads. The method is thus particularly suitable for the investigation of mechanical vibrations.

The article further discusses the possible sources of error and their elimination and describes a "resistance-ring" strain gauge, working on the same principle as the resistance-strip type but with full compensation

Charge of a "COMMANDO"

Giant transport takes off on *AEROLS**

Capable of carrying jeeps and light artillery, as well as paratroops, Curtiss-Wright's "Commandos", used by the Army Air Force, are destined for a vital role in today's lightning warfare.

Equipped with Aerols, these huge, heavily laden transport planes sweep away to swift, sure take-offs. And their landings are feather light, for Aerols effectively cushion all landing shocks.

Today, Aerols are providing performance of this quality not only on "Commandos", but on *every* type of military aircraft. Such service forecasts their importance to the future safety and comfort of travel by air.

THE CLEVELAND PNEUMATIC TOOL COMPANY
AIRCRAFT DIVISION • • **CLEVELAND, OHIO**

Also Manufacturers of Cleco pneumatic tools for the aircraft and general industry, Cleco sheetholders, Cle-Air shock absorbers for trucks and buses, and Cleveland rock drills for mining and construction work.

AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

FLAK-ACK-ACK—"SLEEP! LET ME SLEEP!"

WAR FLYING plays on a man's nerves like a pick on a mandolin. He's got to stay keyed up. Watch those instruments. Watch for the target. Watch for the enemy. Strain. Look now! Keep looking . .

Quiet at last, back at the airdrome. Quiet in bed, no motors pounding, no flak, no ack-ack. Too quiet. Why can't a fellow sleep? Oh, for some sleep. "Grant me the mercy . . ."

It was at the "University of Petroleum," Shell's research laboratories, that scientists first found how to get allyl alcohol, ingredient of one of the most effective and least harmful of sedatives, from "waste" petroleum gases. Flight surgeons now are administering such sedatives to fagged-out flyers—to bring the healing restorative, sleep.

From the genius of Shell Laboratories also came the first 100-octane fuel in commercial quantities . . . one of the reasons the majority of the country's leading plane and engine makers prefer Shell Aviation Fuels. Shell Aviation Products are also preferred by many airlines, aviation training schools, and airports.

Farsighted airport operators will find Shell's wartime popularity a profitable peacetime asset.

First oil refinery to win Army-Navy "E"—Shell's Wood River Refinery

AVIATION FUELS SHELL AEROSHELL OILS

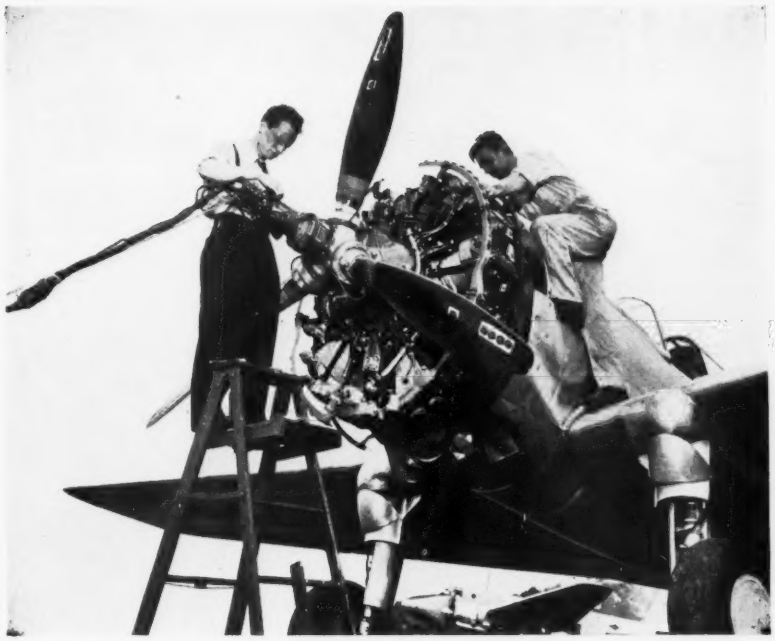
of errors, since the elastic deformation of the ring forming the gauge produces four alternating regions of tensile and compressive stress, which are tapped by four resistance strips forming the arms of a Wheatstone bridge. The measuring range can be adjusted by varying the proportions of the gauge ring, and thus a set of, for example, three ring gauges of varying thickness and diameter will enable deformations between 0.001 and 10 mm. to be conveniently measured, the required measuring length varying between 25 and 100 mm. Finally, the writer compares the behavior of resistance strips and ring gauges under static and dynamic stress and gives examples of the use of such gauges. *Aircraft Engineering*, April, 1943, pages 106–109, 19 illus.; "Airframe Stress Analysis by the Electrical Strain Gage," William T. Thompson, *Aero Digest*, May, 1943, pages 259, 261, 263, 3 illus.

Simple Apparatus for Studying Deformation of Soft Materials Under Compression and Tension at Constant Stress. G. W. Scott Blair and B. Veinoglou. The writers describe apparatus for extending cylinders or strips and also for compressing cylinders in such a way that the load per unit of average cross section remains adequately constant for big strains. The conditions under which this compensation is satisfactory are determined by experiment. It is stated that the accuracy is adequate for most industrial rheological measurements for materials soft enough to be considered as compressible. *Journal of Scientific Instruments*, April, 1943, pages 58–60, 4 illus.

Stressed-Skin Wooden Construction. W. Stepniewski. This is the first of a series of articles on wood in aircraft construction. The writer provides an analytic comparison of the weight of modern wooden or, in general, plastic constructions with the weight of structures of aluminum alloys. Included in this first article is a discussion based on a table of comparative weights of various woods and 24 ST aluminum alloy and a table of shape coefficients and weight ratios. *Aircraft Engineering*, April, 1943, pages 110–112, 2 illus.

Testing

Flight Testing Is a Sound Business. Part II. Edmund T. Allen. This is the second installment of a three-part article by the distinguished deceased test pilot on the science of flight testing. It is concerned with systems of training flight crews, as practiced by the Boeing Aircraft Company. In addition to outlining the progressive course of training, the article describes the equipment used for instructional purposes.



With specially designed equipment, workers are making vibration tests on Curtiss electric propellers.

The first part of the program is composed of 15 lectures extending over a two-week period, followed by seven full-day lectures dealing with the Boeing Flying Fortress. A table of the subjects covered by the 15 general lectures is included in the article. The latter part of the course covers actual practice in various operational procedures and familiarization with the varieties of equipment used for testing. Stating that a considerable amount of time is devoted to instruction in safety procedures at high altitude, the writer also describes the three emergency high-altitude flight procedures that are taught. *Aviation*, May, 1943, pages 118, 119, 417, 418, 2 illus.

Boost Surge. In this fourth installment of "Notes From a Test Pilot's Diary" the writer examines boost surge, one of the less frequent boost troubles encountered in test flying. He describes the symptoms of the difficulty, tells how to determine whether a surge is really present in the engine, and advises how to correct it. The resemblance of fluctuation in the boost gauge to surge is identified. The writer also expresses the opinion that, in general, air-cooled radial engines are less prone to boost surge than liquid-cooled in-line engines. *Flight*, April 22, 1943, page 419.

Electrical Indicator Drives. J. G. G. Hempson. Methods of synchronizing cathode-ray oscillograph engine indicators are discussed. Difficulties encountered are outlined. A method employed by the writer which is stated to have the merit of simplicity and which is adaptable to a large number of cases met in practice is described. *Aircraft Engineering*, April, 1943, pages 98, 99, 5 illus.

Testing Elasticity of Synthetic Rubbers at Low Temperatures. George D. Kish. Quick and practical methods of testing the new synthetic rubber materials are suggested. One of the most important points to be determined is their elastic behavior at low temperatures, for which an instrument called the elastensometer has been devised. The principles are explained and its construction is described. Instructions for conducting a test are given, and the test results are shown, with examples worked out mathematically. It is concluded that tests made with the elastensometer are convenient and inexpensive, since no great outlay is required for equipment. A simple compound can usually be tested in 15 min., including the time required for cutting the test specimen in a drill press. *Aero Digest*, May, 1943, pages 245, 246, 257, 339, 10 illus.

Aileron Control. "Witness." This fifth installment of "Notes from a Test Pilot's Diary" is devoted to an examination of the problems encountered in testing the control of an airplane's ailerons. It is stated that the only test that proves the ailerons throughout the speed range is the terminal-velocity dive. In a consideration of the differences between fabric-covered and metal-covered ailer-

THE JOLT OF *THE THUNDERBOLT** HITS THE AXIS!

*REPUBLIC P-47
HIGH-ALTITUDE FIGHTER

REPUBLIC AVIATION

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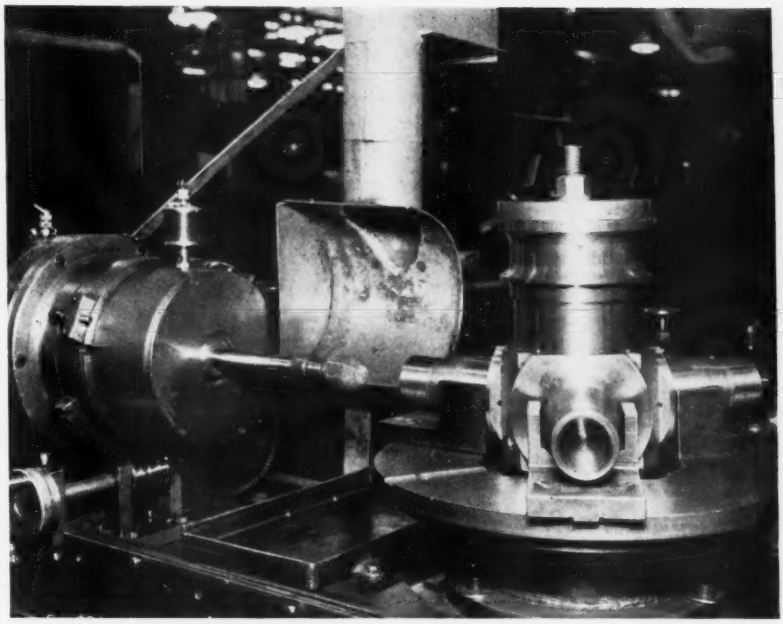
AIR MASTERY THROUGH REPUBLIC AVIATION ENGINEERING EXCELLENCE

ons, the metal covering is acknowledged to afford a stiffer aileron and one with lighter handling characteristics. However, in view of the fact that metal skinning does not entirely eliminate aerodynamic differences due to dissimilarity in the surfaces of a plane's ailerons, the importance of manufacturing to small tolerances is stressed. Among the problems discussed are the causes of overbalance and heaviness and their correction. *Flight*, April 29, 1943, page 448.

Engine Testing. F. C. Sheffield. The subject of this article is the Rootes layout for aircraft-engine testing. Messrs. Rootes Securities, Ltd., repair and overhaul engines for the Royal Air Force, using two plants, one for air-cooled engines and the other for liquid-cooled engines. Especially built, multicell reinforced concrete houses are used for routine tests at each plant. Instead of power-absorption dynamometers, the method of brake fan testing by running the engine with a calibrated airscrew is used. The arrangement and design of the test cells is described and the preparation for the tests is outlined. Sections of the article describe the test-bed equipment, soundproofed test corridor, and the fuel supply system. How the tests are conducted is described. *Aircraft Production*, May, 1943, pages 211–217, 18 illus.



Saving more than two-thirds of the time previously consumed, this special eccentric head polishes spider armbores at the Hamilton Standard Propeller Division, United Aircraft Corporation.

Tools and Equipment

Aircraft Tool Planning. Part II. Richard H. Luders. The continuation of a two-part article describing 20 points essential to good tool planning for aircraft production. In this concluding installment eight considerations are covered: check fixtures, engineering changes, fabrication and assembly time, tooling time, shop loading, shop routing, human error, and shop personnel. *Aviation*, May, 1943, pages 179, 181, 410, 413, 414, 417, 4 illus.

Spar Milling. A description is given of a new heavy-duty spar milling machine introduced by A. C. Wickman, Ltd., of Coventry, England. A feature of the machine is the provision of a hydraulic copying mechanism to control vertical cutting movement when milling spars with profiled sections. Data on the production times obtainable with this spar miller are given. *Aircraft Production*, May, 1943, pages 230–233, 5 illus.

Quicker and Cheaper Setup Method for Drop-Hammer Dies. A brief description of some methods by which drop-hammer dies have been evolved. The development of T-slotted beds is said to provide quicker and better positioning for clamping kirksite dies with pointed thrust screws. The entire elimination of the pointed thrust screws and their attendant disadvantages is achieved by molding the dies with lugs along the sides and using specially designed clamps that thrust directly downward against these lugs. Another development provides for simple cores by which recesses are molded in the die walls. These recesses, it is claimed, afford equally satisfactory clamping surface as the lugs. *Aero Digest*, May, 1943, page 157, 3 illus.

Training

Telegraphist Air Gunner. J. Russell. This article deals with the training of the telegraphist air gunner, whose chief duty is to maintain wireless telegraphic communication. Details of the training course, which takes up about one year, are outlined. *Aeronautics*, June, 1943, pages 54, 55, 2 illus.

Training for a Career. L. C. Jarman. Advice is given to British boys on how to qualify for the Higher National Certificate in Engineering. Preparatory technical courses for pre-apprenticeship study are outlined and suggestions for secondary-school entrants are also made. Aspirants for the Certificate are counseled that to be competent draftsmen or designers they should receive part of their initial training in workshops. *Flight*, April 15, 1943, page 386.

Grasshopper Haven. Leighton Collins. This article deals with the Department of Air Training of the Field Artillery School at Fort Sill, Okla. It describes the observation work done by light planes for the field artillery, reviews the establishment of the department, and explains the advantages of having the grasshopper units trained and directed by the Field Artillery rather than the Air Corps. It outlines the training course given to the pilots of the Field Artillery and includes data on the instructors who are carrying out the program.

Flight training at Fort Sill is divided into three stages: Following the pattern of the C.A.A. flight-test sequence, the first part consists of six dual and six solo flying hours, since candidates are supposed to hold the equivalent of a private pilot's license. The training sequence of the second stage is detailed by the article; emphasis is placed upon the pilot's ability to land and take off on any spot that is required. In stage three, the pilot gets back to his primary objective of becoming an artilleryman; he is taught aerial adjustment of artillery fire and tactics and the technique of employing Field Artillery air observation. *Air Facts*, June, 1943, pages 7–18, 7 illus.

Toadstools Are Their Dish. Lt. Fred Tupper. The training in opera-

Uncle Sam's flying postman is more than a fledgling, today. His wings are both broad and sturdy... as evidenced by the tremendous increase in air transportation of mail.

For example, American Airlines Flagships carried 1,996,352 pounds of airmail in April... an increase of 90% over the poundage of April, 1942, and 450% more than the airmail cargoes of April, 1938. Air express cargoes increased some 1500% in this 5-year period... from 112,644 pounds to 1,779,372 pounds in April, 1943.

For lubrication that keeps its great fleet of Flagships giving dependable transportation to passengers and mail, American Airlines relies on Sinclair Pennsylvania Motor Oil.

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FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE NEAREST SINCLAIR OFFICE
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tion and maintenance of power turrets for Allied and enemy planes is discussed. It is noted that the Navy has established a turret school at the Chicago Vocational School where men are trained in the maintenance and overhaul of the various types of gun turrets used in naval aviation. The training methods at this school are outlined. *Air Trails*, June, 1943, pages 19, 56, 57, 2 illus.

Shaw Field "Air Conditions" Pilots with Weather Simulator. A description of a device that simulates atmospheric conditions for Link Trainer instruction. Used at Shaw Field Basic Flying School, this weather simulator enables student pilots to learn the fundamentals of instrument flying without leaving the ground and aids them to grasp the principles of meteorology. It consists of a 16-ft. heavy paper band, 12 in. wide, on which has been drawn a graphic cross-sectional picture of a blanket of air 6,000 ft. thick and approximately 800 miles long. Moving slowly between two rollers at the opposite ends of an upright panel on the Link instructor's desk, the band, with its panorama of warm and cold air fronts and diagrams of the weather phenomena that result from the meeting and fluctuation of the two, represents an air mass moving across the instructor's desk map and the air through which the Link student is "flying." *The American Pilot and Aircraftsman*, May, 1943, pages 16, 17, 4 illus.

The Renshaw System. Lee Kent. How Dr. Samuel Renshaw developed an aircraft recognition training system is described. It is stated that the system is based on the theory that the ability to see and reproduce visual forms responds very highly to training. The writer explains that the recognition training school has three missions: to teach officer instructors the theoretic background of the system; to train them to recognize and identify planes and ships quickly and accurately; and, finally, to train them how to teach what they have learned. *Air Progress*, June, 1943, pages 40, 41, 65, 66, 3 illus.

Scrapped Veterans. C. Budd Dugan. This article tells how, before they are scrapped, old and obsolete Navy airplanes are used as subjects for training student machinists' mates and metalsmiths of the naval air forces. Stripped of their radio equipment, flight instruments, and armament, they provide the trainee in "Squadron Operations" with a means of practical experience in aircraft servicing. By starting, running-up and stopping their engines the student is schooled in preparing a plane for flight. He also receives actual practice in servicing an aircraft by ship and shore methods, running inspection and engine checks, doing routine upkeep and minor repairs, and replacing major assemblies.

The goggles shown illustrate the new Lumarith method of training for instrument flying. (*See* page 137.)

The writer names specific airplane types that have been used for this purpose. *Flying*, June, 1943, pages 40, 41, 172, 173, 3 illus.

The Art of Seeing with the Mind's Eye. E. C. Bailey. The importance of teaching a student pilot to fly with the help of his senses is stressed and suggestions on how instructors may develop awareness and comprehension in their pupils are made. The building of confidence is regarded as an important factor, and frequent demonstrations of a maneuver are advised, as well as explanations of the correct theory upon which a maneuver is based. *Air Facts*, June, 1943, pages 32–39.

Horsepower to Give the Fledgling Wings! Important part Canada has taken in the group training of combat and transport pilots is emphasized. Discussing the training of pilots, the writer states that handling an aircraft power plant in flight is as much a part of flying as the handling of the elevator or rudder. The design and operation of the Jacobs L-4MB engine, which is widely employed in the training of the Empire's fighting pilots because it is used to power the Cessna Crane trainers, is discussed. *Air Force Review*, June, 1943, pages 6, 7, 26, 4 illus.

So Your Son Wants to Be a Pilot! Kenneth Brown Collings. A method of indoctrinating youngsters with the fundamentals of flying safety is described. The writer tells how he schooled his own son by telling him vividly interesting stories, each of which contained a "sugar-coated" moral. The stories illustrated the following lessons: (1) The easiest way to forget a routine safety precaution is to let something else distract your attention; (2) show-off acrobatic flying at low altitudes was the outstanding cause of the 15 fatal accidents analyzed by the Air Safety Board in November; (3) keep your nose down on the turns; (4) fly low and slow. *Air-Age*, August, 1943, pages 24, 25, 53–55, 3 illus.

Post Graduate School. William Flynn. A description of the Pan American Airways Pacific Division school, where qualified junior pilots are trained to fly transoceanic Clippers. At the so-called "basic" school, mastering the fundamentals of instrument flight is indicated as the student's primary task. In addition to outlining the course of training, the article touches upon the following points: qualifications for admission to the school, salaries paid to students while learning, living facilities, instructors, methods of instructing, and equipment. *Air Facts*, June, 1943, pages 53–59.

Machining Problems in Aircraft Construction. J. P. Johnson. Means of training the large numbers of inexperienced men who are coming into the aircraft industry are suggested. It is emphasized that new men must be taught to be meticulous in their workmanship and that they be taught the serious consequences of allowing a bad piece of work to get into the mechanism of an airplane. Strict care should be given to tools and fixtures. The importance of good inspection on the floor is stressed. The problem of recruitment is discussed. *The Draftsman*, May, 1943, pages 22, 23, 1 illus.

The Air Forces Go to School. Howard L. Hurwitz. The types of Technical Training Command schools of the U.S. Army Air Forces are listed. Twenty-seven regular courses and ten advanced courses are named. The article also outlines entrance requirements for these schools and presents some brief information on the instructors, courses, and methods of teaching. *The American Pilot and Aircraftsman*, May, 1943, pages 18, 19, 12 illus.

Educated to Fly. Lt. (j.g.) John B. Goodman. The various aspects of the Navy's program for training aviation cadets are discussed. American training methods are contrasted with those used by the Germans and Japanese. The Flight Preparation School, a new phase of training started last January for the education of young aviation cadets, is described. It is explained that 20 colleges were taken over for this training. The methods of instruction used to train young cadets are described. *U.S. Air Services*, May, 1943, pages 14, 15, 52, 2 illus.

Warfare

Secret Rocket Weapons Blast Tanks and Planes. Leonard Engel. It is stated that rocket weapons are playing

an increasingly important role in military operations. Devices based on the rocket principle are in use to discharge projectiles, to trap and disable raiding aircraft, to increase the striking power of bombs, and to produce an extra take-off boost for planes carrying an overload of fuel or explosives. Advantages of the rocket gun are reviewed. Since a rocket is self-propelling, no extreme power explosion is required to send it off. The discharge mechanism is not required to withstand sudden violent pressure, and there is no sharp recoil requiring elaborate compensating mechanism. Rockets can be fired from lightweight tubes mounted on relatively flimsy platforms. Rocket projectiles fall into two classes, solid fuel and liquid fuel. It is explained that the military projectile rockets now in use are all of the solid fuel type. The solid explosives that have been employed with success and rocket bombs and rocket motors for use in assisted take-offs are described. *Popular Science*, July, 1943, pages 50–54, 5 illus.

Battle Log of the Fortress. This is a review of the B-17's combat record. Starting with December 10, 1941, and proceeding through March 31, 1943, it presents chronologic notes on the battle achievements of the Flying Fortress on world-wide fighting fronts. *Western Flying*, May, 1943, pages 44–46, 1 illus.

Fundamentals of Air Fighting. Derived from official United States communiques, the primary principles of air combat tactics are reviewed. These are outlined under the following headings: gunnery principles, air fighting principles, some do's and don'ts, formation principles, evasion principles, antiaircraft evasion, and physical fitness. *Flying*, June, 1943, pages 24–27, 4 illus.

Welding

Foolproof Procedures for Precision Production Welding. Frank Shaw and Valmore Forgett. To exemplify the manufacturing practices employed at Glidden-Buick's Aircraft Parts Division, this article presents detailed descriptions of the planning, tooling, and fabrication of certain parts, with particular attention paid to the jigging of parts to be welded. The first procedures examined are those that were established for the production of a drag link or tail wheel supporting assembly. The two chief fabrication problems—maintaining dimensions and avoiding cracking—were both met by following an elaborate, carefully planned sequence of oxyacetylene welding. With skip welding practiced throughout to avoid distortion and preserve dimensional accuracy, the welds were laid down in small deposits to reduce the heat input at any one point.

What an enemy shell can do to a modern warplane propeller is illustrated in this photo taken in the Mid-East of a Curtiss electric propeller torn by enemy fire during combat.

The second group of procedures are those in connection with the fabrication of seaplane beaching gear. They offer an illustration of a problem calling for the jigging of parts during every stage of assembly.

Emphasis is placed upon the advantages in downhand or flat-position welding. It is stated that this type of welding requires less skill, attains greater speed, and produces uniformly sound, high-quality deposits. The conversion of personnel which was necessary when the company first started its welded fabrication of precision aircraft parts is also discussed. *Aero Digest*, May, 1943, pages 237, 238, 241, 242, 337–339, 9 illus.

Spot Welding in Design and Production of Aircraft. G. S. Mikhalapov. The beginning of a two-part article that was originally presented as a paper before the National Aircraft Production meeting of the Society of Automotive Engineers. The writer outlines the advantages of spot welding and explains why the aircraft industry has been slow to adopt this method of joining sheet metal. He analyzes the objections to spot welding for air-frame fabrication under the headings of material, quantities produced, and structural requirements and then goes on to show why these objections no longer hold true.

In questioning at what source the more general substitution of spot welding for riveting in the aircraft industry would be promoted, the production engineer and the shop superintendent are selected as the two men most likely to advocate the use of spot welding to its fullest extent because they are directly concerned with facilitating fabrication and higher production per man-power unit does result from the reduction of costs through the use of spot welding.

The writer also defines the extent to which spot welding is being employed by the aircraft industry at present. Among his computations is one that states that an average of at least 10 per cent of all joints composing a typical airplane are being spot welded. However, the majority of these joints, he claims, are the so-called secondary, and some semistructural, parts. To date there is stated to be only one aircraft builder who is completely spot welding all parts of the air frame which are at all adapted to the process. *Canadian Aviation*, May, 1943, pages 100, 102, 104, 106, 3 illus.

Health Aspects of Welding. A. G. Cranch and B. L. Vosburgh. Some practical suggestions are given for the better protection of the health of welding operators. It is explained that health hazards in welding can be divided into "real" and "unreal" classes. Real hazards should not be ignored or minimized. They are usually easy to recognize and effective preventive measures are available. Unreal hazards are often alleged. If indicated precautions are taken to guard against the real hazards, the unreal will disappear. Real welding hazards are due to radiation and to air contamination by gases and fumes.

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The Snowball that Rolled Uphill!

It was a steep and rugged hill that U. S. aluminum production had to climb back in 1940. The total Axis output was twice our capacity. France was doomed. England was fighting for its life.

But that year, men of vision in the aluminum industry saw what was ahead and began pushing. It was tough going. But swiftly, surely, the snowball of aluminum production rolled uphill.

Reynolds has contributed much to this great effort. Long before Pearl Harbor, we staked all our resources to provide a new source of aluminum—to mine our own Bauxite ore—to build mammoth new factories—to turn out hundreds of millions of pounds of finished metal.

Spurred by Reynolds foresight and daring, the snowball has rolled over the top of enemy output. Now, with the tough uphill battle won, this shining snowball is gathering momentum to crush the Axis.

And when our boys come flying home from victory, they'll fly straight into a new Age of Aluminum . . . a plentiful supply of the miracle metal that *does so many things so much better.*

REYNOLDS METALS COMPANY
General Offices, Richmond, Va.
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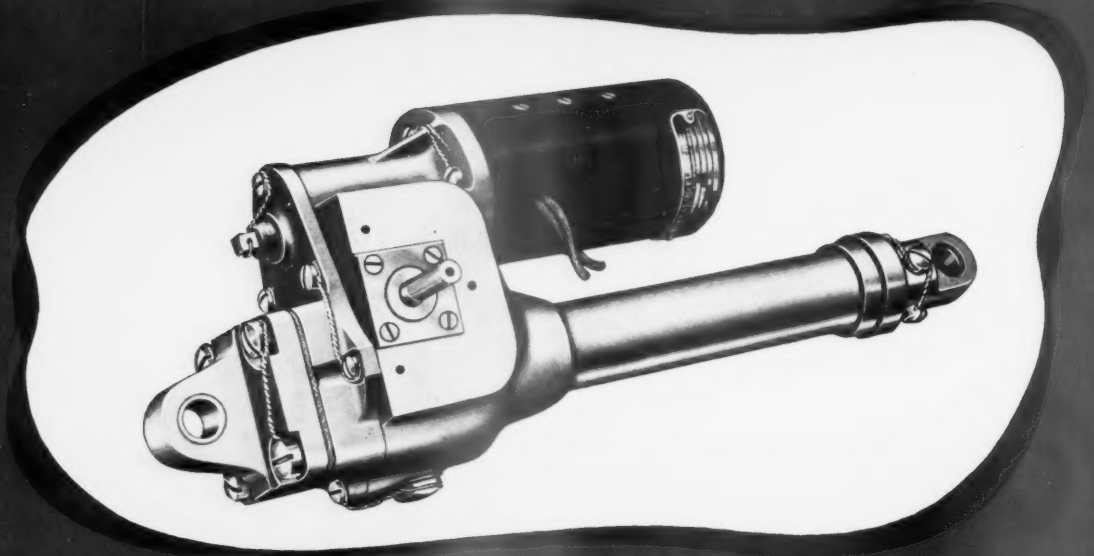
37 PLANTS IN 13 STATES

INTRODUCING



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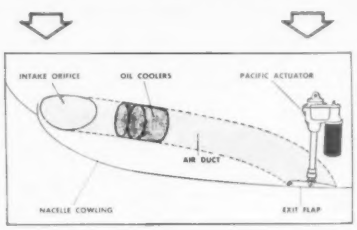
Aircraft engineers have now passed through the stage that early automotive designers waded through, when everything had to be designed down to the last nut and screw.

Now the Aircraft Industry has developed its approved accessories. Now the Aircraft Engineer can turn to actuating units complete and ready to install. Units which have been analyzed, boiled down and engineered till Hell won't have 'em. Units approved by Army and Navy.

One of these is the Model E-1134, motor driven (electric or hydraulic), jack type, linear Pacific Actuator, designed especially for operating cowl flaps, oil cooler flaps, or similar jobs. It weighs but 8 lbs. complete, is 5-5/16 in. high, 5 in. wide and 18 in. long max. extension. It has been tested under all conditions and is warranted for a tension load of 1400 lbs., compression load of 800 lbs. This is but one of dozens of such Pacific Actuators—ready to do a complete job on America's best planes.

FOR OIL COOLER FLAPS



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Both classes of real hazards are discussed. *The Welding Journal*, May, 1943, pages 343–346.

Atomic-Hydrogen Arc Welding Aids Production. R. A. Wyer. The nature and action of atomic-hydrogen arc welding are explained, some of its uses are noted, and its advantages are cited. In addition, comparisons are made between atomic-hydrogen and ordinary gas or metallic arc welding. Although the atomic-hydrogen process is admitted to be inherently slower than metal arc welding, its application is indicated for cases where quality and not speed is the governing factor. However, it is stated that this method of arc welding often speeds production because it permits welding without flux and because it cuts the time of subsequent grinding or finishing. *Flying*, June, 1943, pages 103, 104, 115, 7 illus.

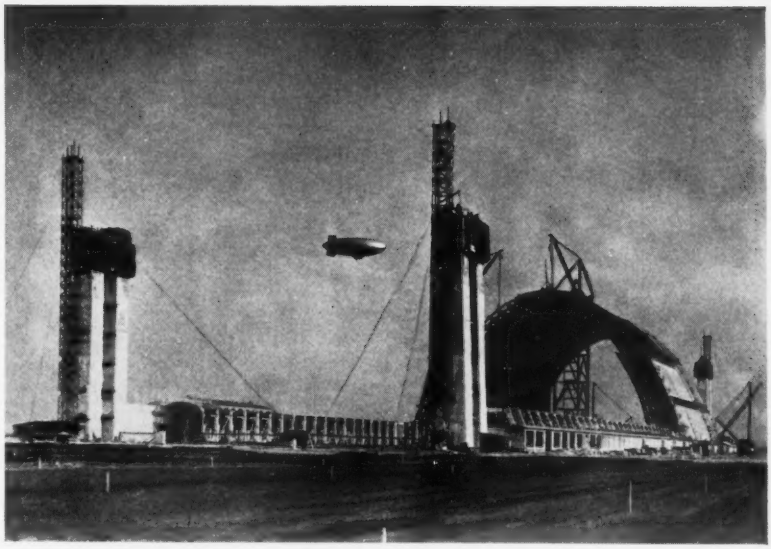
Seam Welding with a Carbon Arc. R. A. Tobler. A method and technique of seam welding light-gauge steel, using the carbon arc instead of the metal arc, is outlined. The method is reported to save metal, time, and money. *Metals and Alloys*, May, 1943, pages 968, 969, 1 illus.

The Contribution of Resistance Welding Control to the War Effort. H. L. Palmer. Recent developments in resistance welding controls which have aided the industry's war effort are described. It is explained that energy-storage resistance welding of both the capacitor and inductor type has been extensively developed as an improved tool for the welding of aluminum. Conventional a.c. resistance-welding control has been expanded to meet the exacting requirements of welding the many new alloys made available for war use. A current regulator has been developed that will maintain constant current through the weld even though the line voltage may vary or the secondary throat conditions change. Special sequence controls are available to meet any cycle of power applications found necessary to weld and heat-treat the material to be fabricated. The demand on overloaded lines can be reduced by means of power-factor correction. *The Welding Journal*, May, 1943, pages 347–349, 3 illus.

Miscellaneous

Theory and Technique of Perspective Projection. Part IV. George F. Bush. The fourth article in this series considers interiors, expedients, and pseudoperspectives. The reader is referred back to earlier installments, since it is necessary to review some of these remarks and to recall the points made in previous discussions of perspective drawing. It is emphasized that a cardinal principle is that an illustration should show that which an eye would actually see without turning the head and with looking almost, if not directly, at the object. A final suggestion is made concerning interiors in perspective, the procedure being outlined in three steps. A perspective scale is described which may be used to obtain the perspective of a circle or an ellipse more quickly than by the point-by-point method.

Pseudoperspective is defined as a theoretically incorrect form of perspective projection, which, however, is more rapidly obtained and for certain purposes is just as satisfactory as a true perspective. Brief comments are made on the use of pseudoperspective and its applications in practical work. *Aviation*, May, 1943, pages 194, 197, 375, 3 illus.



This perspective view shows the United States Navy's giant all-timber blimp hangar. This timber structure was made possible by the use of timber connectors. The arches have a clear span of 153 ft. and provide a 237-ft. unobstructed opening. The hangar is 1,000 ft. in length.

Wings of the Army Air Forces. Gerald Brenner. A brief outline of certain Army regulations listing ratings open to officers, warrant officers, flight officers, and enlisted men of the U.S. Army and placing command of tactical units of the Army Air Forces only in Air Corps officers qualified as pilots. In addition, the article reviews the list of Army personnel who are entitled to wear wings and relates the qualifications required for each job. The classifications given are: Command Pilot, Senior Pilot, Pilot, Liaison Pilot, Senior Balloon Pilot, Balloon Pilot, Glider Pilot, Senior Aircraft Observer, Aircraft Observer, Technical Observer, Flight Surgeon, and Air Force Technicians. *Air-Age*, August, 1943, pages 15, 59–61, 1 illus.

Timber Connectors in Hangar Construction. Holman Harvey. An article on the construction, operation, and applications of split-ring timber connectors. Their usefulness to the aircraft industry is illustrated by details on how the U.S. Navy employed this system of construction for a nonrigid airship hangar, called the world's largest. It is explained why the use of connector rings enabled the construction of a huge timber edifice that could not otherwise have been built and permitted the saving of hundreds of tons of structural steel. The trade name of the connectors and the firms that manufacture them are noted. *Commercial Aviation*, April, 1943, pages 110–112, 4 illus.

World Bases After Victory: We Face a Delicate Problem. The problem of establishing postwar armed bases to restrict aggression is studied. It is emphasized that the military-base problem must be considered now and not after the war is over. Bases must be located first in plan and then in actuality.

In discussing base requirements, it is noted that planners usually regard the Pacific Ocean as one unit, the Atlantic area as another, and the European-African-Asiatic zone as a third unit. While air transport is considered in the discussion, sea commerce and transport are still looked upon as the basic bulk-hauling medium. A map shows present and potential bases planned to win and hold the peace. *Newsweek*, April 12, 1943, pages 25–32, 4 illus.

(*Continued on page 163*)

They're coming,
Tojo!
BREWSTER BLASTERS
▶ on the Line
▶ on the Deck
▶ in the Fight
▶ in QUANTITY
Brewster
BUCCANEER AND BERMUDA DIVE BOMBERS • NAVY CORSAIR FIGHTERS

Government Publications

Army Air Forces

Matériel Command's Program to Help Small Businessmen. An outline is given of the facilities that have been provided by the A.A.F. Matériel Command at Wright Field to facilitate the handling of larger numbers of contracts with small business organizations.

The article also outlines the various divisions of the Matériel Command and the work performed by each of these divisions or sections. *A.A.F. Matériel Command*, Wright Field, Dayton, O.

Florida's Combat Theatre. Brig. Gen. Hume Peabody. The Army Air Forces School of Applied Tactics at Orlando, Fla., is described. This is the school where key personnel of the new Air Forces groups similate modern air warfare before going overseas. A chart shows the organization of the school. *Air Force*, June, 1943.

Oxygen Is Your Life! The Air Surgeon offers advice on the importance of the ready accessibility and proper use of the oxygen supply for high-altitude flying. He recites instances where carelessness in these respects resulted in the unnecessary loss of the lives of airmen. The oxygen equipment used in present aircraft is explained, and emphasis is placed on the care that must be given to the equipment at all times. *Air Force*, June, 1943.

High Level Jumping. This article on parachute jumping is based on information from the Office of the Air Surgeon, at Headquarters, and the Matériel Center at Wright Field. The free fall, oxygen equipment, loss of consciousness, and other factors in parachuting from altitude are discussed. A chart shows the comparative rates of free fall and descent by parachute from an altitude of 40,000 ft., and a diagram shows the means of emergency escape from a B-17 bomber. *Air Force*, June, 1943.

If You're Going to Mid-Africa. Major Stephen L. Gumport. A flight surgeon of the Army Air Forces describes the conditions soldiers will encounter in central and western Africa and tells how to guard against diseases and make friends with the natives. It is pointed out that malaria and dysentery are prevalent in those sections of Africa.

The possibility of creating a drug that will actually prevent development of malaria is being worked on and may prove one of the greatest possible aids toward opening the tropics to white men. At present, however, it is stated that most medical men feel that neither quinine nor atabrine when taken regularly in prophylactic doses will prevent a person from developing the disease. These drugs, taken in this manner, very possibly act as "suppressives" and may actually suppress the symptoms while being taken. However, soon after the medicine is stopped the individual may come down with malaria that actually was acquired weeks before. It is shown that when these drugs are taken for this purpose they should be used regularly, since it is not only useless but may actually be dangerous to use them intermittently. It should be borne in mind that the type of malaria most prevalent throughout this area differs greatly from the type of malaria that occurs in the United States. *Air Force*, June, 1943.

European Weather. Major Joseph J. George. To aid pilots of the Army Air Forces, an outline is given of weather conditions in Europe at different times of the year. Diagrams show the movement of cold and warm air fronts at different seasons of the year. *Air Force*, June, 1943.

Prepare for Trouble! The proper selection and use of emergency kits is described in an article prepared by the Arctic Desert and Tropic Information Center, Eglin Field, Fla., whose function it is to prepare and disseminate information on all aspects of Air Forces operation in nontemperate zones. The article covers first-aid equipment, flotation equipment, sustenance and implement kits, personal kits, and airplane kits. A chart of Army Air Forces emergency equipment and kits is shown. *Air Force*, June, 1943.

Aerial Torpedo. Capt. J. P. Muri. The commanding officer of an Army Air Forces squadron describes the use of an aerial torpedo in warfare. He explains that the torpedo is an involved mechanism and has certain characteristics that govern the manner and speed and height of its launching if a high probability of success is to be assured. Thus, flying technique must be suited principally to the projectile rather than to the plane. The torpedoes of all nations are similar and therefore the technique of launching them is similar the world over. The article deals only with torpedo attack by land-based aircraft and is mainly devoted to torpedo tactics with medium bombers. *Air Force*, June, 1943.

National Advisory Committee for Aeronautics

The Heat Transfer to a Plate in Flow at High Speed. E. Eckert and O. Drewitz. A translation of an article "Der Wärmeübergang an eine mit grosser Geschwindigkeit längs angeströmte Platte," *Forschung*, Vol. 11, No. 3, May-June, 1940. The heat transfer in the laminar boundary layer of a heated plate in flow at high speed can be obtained by integration of the conventional differential equations of the boundary layer so long as the material values can be regarded as constant. This premise is fairly well satisfied at speeds up to about twice the sonic speed and at not excessive temperature rise of the heated plate. The general solution of the equation includes Pohlhausen's specific cases of heat transfer to a plate at low speeds and of the plate thermometer. The solution shows that the heat transfer coefficient at high speed must be computed with the same equation as at low speed when it is referred to the difference of the wall temperature of the heated plate in respect to its "natural temperature." Since this fact follows from the linear structure of the differential equation describing the temperature field, it is equally applicable to the heat transfer in the turbulent boundary layer. *N.A.C.A. T.M. No. 1045*, May, 1943.

Civil Aeronautics Administration

Index to Current Memoranda. A list is published of memorandums previously issued which are still in effect. Omissions over the previous list represent memorandums that either have been superseded or have since served their usefulness and, hence, may be discarded if desired. Certain memorandums, although still current, are out of print and will not be reprinted pending their incorporation in appropriate handbooks, manuals, etc. A complete list (by numbers) of all Safety Regulation Releases to date which have been superseded and the reason therefore is also included.

In view of the many diversified activities of Safety Regulation, a specified method of distribution is used in order to avoid transmittal of material to uninterested persons and to provide a complete file of all publications for all interested persons. The original distribution will be made only to those affected directly. Releases will be sent to the following classes: accessories manufacturers; engine and propeller manufacturers; aircraft manufacturers; scheduled air carriers; air-carrier officials; engineers, consultants, etc.; and repair stations.

Every effort will be made to ascertain that all persons affected will be served; but, to provide for any contingency, an index will be issued periodically to all of the classes listed.

Safety Regulation Releases will be issued only when the contents are of value to a considerable number of persons or of such nature that the purpose can better be served by such procedure than by individual correspondence. Only one subject matter will be covered in one Release except in those cases where it is impractical to separate them. Whenever a revision is necessary, a complete new Release with a new number will be issued superseding the previous Release. *Safety Regulation Release No. 146*, May, 1943.

Civil Aeronautics Board

Civil Air Regulations. Amended sections of the Civil Air Regulations have been issued as follows: Part 22—Lighter-Than-Air Pilot Certificates, which designate changes that have been made in numerous individual paragraphs of the earlier regulations; Part 27—Aircraft Dispatcher Certificates, which also gives detailed changes, paragraph by paragraph, applicable to the former regulations.

Office of War Information

American Air Transport. A report has been issued covering phases of American air transport at the present time. Among the facts brought out in the report are the following: (1) The Army Air Forces Air Transport Command alone is larger than all air transport organizations, civilian and military, in existence all over the world before the war. (2) The Naval Air Transport Service and the commercial air lines are also carrying great quantities of cargo and great numbers of personnel, chiefly of a military nature, and all operations are steadily expanding. The number and length of air routes flown increase constantly. (3) These achievements are being made in passenger and bomber planes, many of the older and the newer models being converted for cargo-carrying needs. Not a single plane originally conceived solely to carry cargo is in service in the Western Hemisphere at the present time, although several are in the process of design and manufacture. (4) The Army and Navy air transport services have been greatly aided in their work by the activities and by the personnel of the commercial air lines. (5) This great wartime expansion of air trans-

3 THINGS TO DO

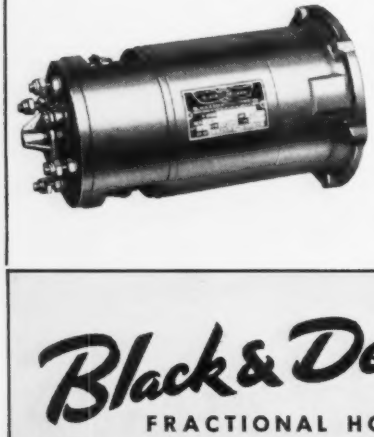
IF YOU ARE PLANNING A *NEW* PRODUCT WHICH REQUIRES A

Special Application Motor

1 Consider the suppliers with the most successful experience in the design and manufacture of special application (fractional horsepower) motors.

2 While the product is still in the early stages of development, select the company which in your judgment is best qualified to work with you in solving the problem.

3 Place your motor problem entirely in their hands or permit their engineering department to work with yours.



Many manufacturers have found that we fulfill all these important requirements both from the standpoint of engineering and production.

Write us about your problem and we shall be glad to send full information or arrange to have one of our representatives call.

THE BLACK & DECKER ELECTRIC CO.
KENT, OHIO

Black & Decker
FRACTIONAL HORSEPOWER
SPECIAL APPLICATION MOTORS

The "Northrop group" of Americans doesn't fool around

It is twenty-five minutes to midnight. Toward their jobs walk some of the thousands of our home front fighters, men and women whose work tonight will fly by tomorrow's dawn

THEY ARE filtering in to take over the graveyard shift. Inside, the swingshift is working. Mechanical "routers" whine through metal—you can hear the din of rivet guns. At quarter to midnight an electric whistle will sound and the swingshift will lay down their tools, but at that moment the men and women you see here will be at their places, working.

There is no waste interval between shifts in this plant. *The Northrop group of men and women doesn't fool around.*

Men known wherever planes are flown lead this Northrop group. Around them they have gathered many kinds of engineers and production men . . . group leaders . . . men and women who have become skilled at riveting, welding, sheet metal fabricating . . . all the thousands of earnest, able people it takes to whip dead metal into living warbirds.

Folks come here from many places, out of many walks of life—and stick! They stick to this group that doesn't like slowdowns or lost time. Why is that?

Maybe the Northrop group works together because nobody around here has any use for red tape or pride of position. Maybe because a person working on Northrop's part of the production battlefront *knows* he's doing a real job of fighting the Axis.

For in the over-all plan of U.S. plane production, vitally important tasks have been given to the Northrop group. Tasks that have placed many fighting warplanes on the battlefronts of the world. Tasks that challenge the best in any man or woman.

NORTHROP AIRCRAFT, Inc.

NORTHROP FIELD, HAWTHORNE, CALIFORNIA

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

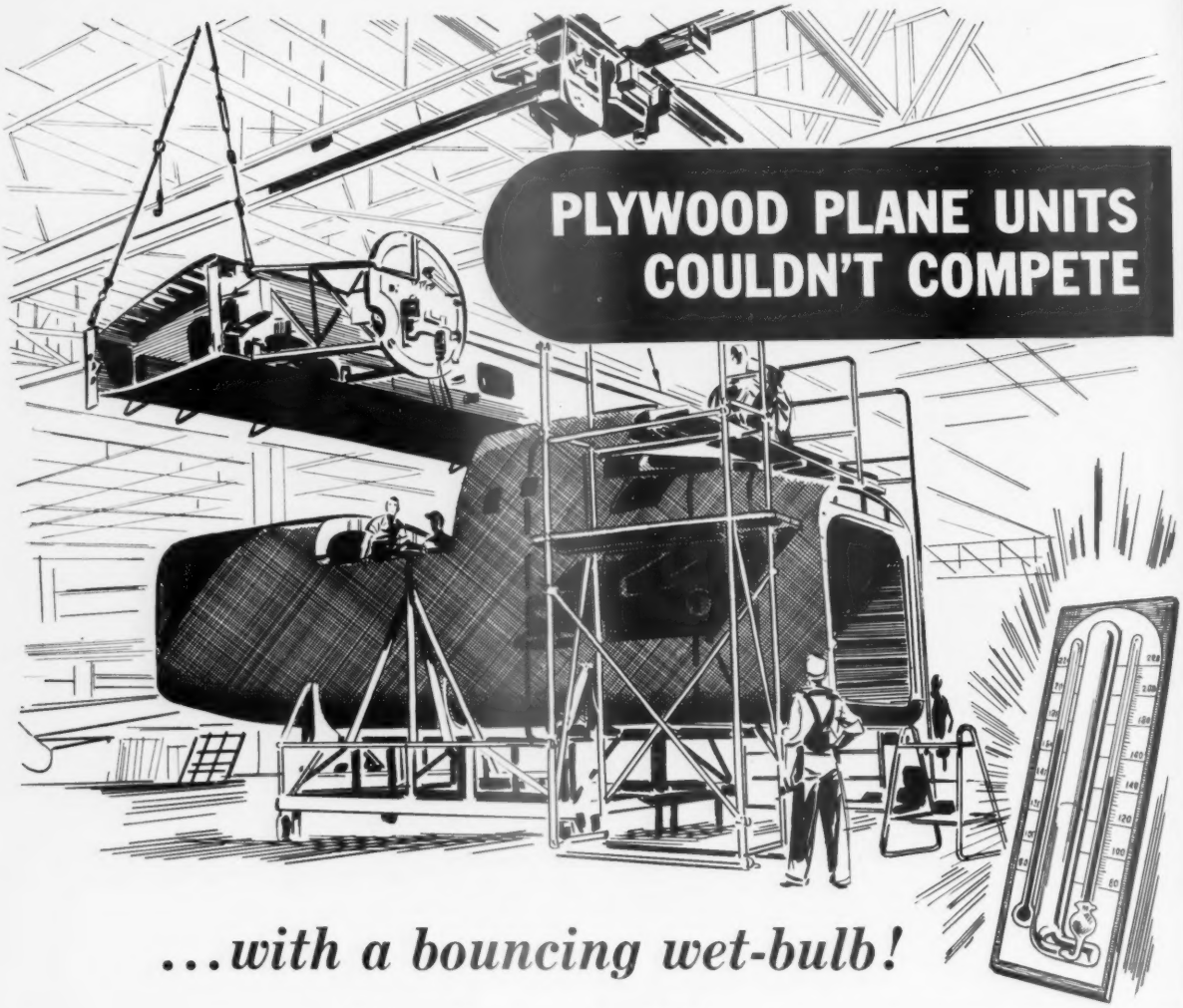
A NORTHROP "FIRST" IN 1934

Coast-to-coast with air mail in 11 hours 31 minutes

The airplane above is a Northrop "Gamma" designed and built ten years ago by the Northrop group.

On May 14, 1934, Transcontinental & Western Air flew this single-motored ship, fully loaded with mail, from Burbank, California to Newark, N. J. in just 11 hours, 31 minutes—five hours faster than today's scheduled air mail.

Other Northrop "Gammas" sold to China were the first attack bombers. Today Northrop "Gammas" are still serving the United Nations actively on at least two continents.



PLYWOOD PLANE UNITS COULDN'T COMPETE

...with a bouncing wet-bulb!

STURTEVANT EQUIPMENT FURNISHED FOR THE FOLLOWING PLANTS
in the Aviation Industry

- Bendix Aviation Corp.
- Boeing Aircraft Co.
- Brewster Aeronautical Corp.
- Curtiss-Wright Corp. (3 plants)
- Curtiss-Wright Propeller Div.
- Fairchild Engine & Airplane Corp.
- Firestone Rubber & Latex Prod. Co.
- Ford Bomber Plant
- Ford Engine Plant
- Goodyear Aircraft Corp.
- Marietta Bomber Plant
- Glenn L. Martin Co. (3 plants)
- Studebaker Aircraft Engine Co. (2 plants)
- Wright Aeronautical Corp. (2 plants)
- United Aircraft Corp.
- Pratt & Whitney Div.
- Hamilton Standard Propeller Div.
- Numerous Naval Air Stations and Lighter-Than-Air Bases

It happened in a piano factory. With plenty of know-how in the fabrication of plywood, the Baldwin Company, Cincinnati, Ohio, was a natural to land a big contract for making plywood aircraft units for Curtiss-Wright cargo planes, shown being assembled above. But, they ran smack into a tough problem of humidity control, in maintaining uniformity of the wings and meeting strict government standards.

Units made one day when humidity was low, would not be identical with those made the next, when the weather changed. So in went seventeen separate and distinct air conditioning systems—designed and installed by Sturtevant—*to circulate more than 8 million cubic feet of air an hour*—to maintain the exact wet-bulb reading required for each stage of manufacture.

Results—gluing time meets government standards, is always the same.. fabrication and handling speeded up, completed units are absolutely uniform.

Humidity control is just one of the problems that Sturtevant Engineers are solving for the aircraft industry... supplying engineered systems and equipment for cooling engines on test; controlling hazardous dust and fumes; conveying chips and other light materials; controlling temperature for precision machining operations ... in short, helping to speed production wherever aircraft and their components are made.

Do you face a particular problem that Sturtevant can help solve? With 83 years of air engineering experience, we are in a position to work closely with engineers who are producing aircraft for today or designing it for tomorrow.

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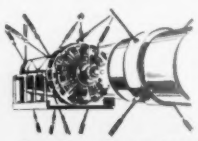
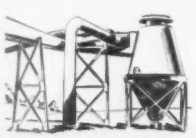
Puts Air to Work

Units or systems for Heating and Ventilating

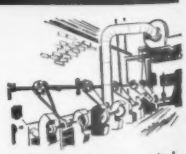


Fans for cooling engines in test blocks



Pneumatic conveyors for sawdust, metal shavings, etc.

Air conditioning for manufacturing areas



Systems for the control of Dust and Fumes

port is being accompanied by a vast, world-wide development of airways, communications, and air ports which will be available to serve civilian air transport needs after the war. (6) During 1943 the total production of the American aviation industry—cargo and combat planes together—will reach the total of $20,100,000,000, a fourth of the nation's war budget for the year and almost a seventh of the estimated national income. This is in contrast to the automobile industry, which at its peak in 1941 reached only to $3,700,000,000. About 2,500,000 trained workers are now turning out combat and cargo planes, and almost all airplane plants are capable of total conversion to the production of civil aircraft. (7) Nevertheless, the Civil Aeronautics Administration warns against extravagant claims on the subject of future peacetime air transport. High cost per ton-mile (not a prime consideration in military operations) and immense problems of refueling are deterrent factors, and it is unlikely that the "airplane will drive other forms of transportation out of business," as some aviation enthusiasts are inclined to prophesy.

The O.W.I. report was prepared in consultation with the Civil Aeronautics Administration, the Civil Aeronautics Board, the War Production Board, the Air Transport Command, the Naval Air Transport Service, and other public and private organizations.

War Department

The Bureau of Public Relations of the War Department has inaugurated a biweekly news sheet titled *Army News*, carrying brief releases describing developments within the Army of particular interest to business and technical publications and those engaged in fields connected with the war effort.

The first issue includes a brief item on "Cannibalizing in the Army Air Forces," which illustrates the importance of spare parts for aircraft at the

war fronts and the efforts that are made to keep every possible plane flying. It tells how damaged aircraft are repaired wherever possible and how the parts of planes are salvaged, to be used as spare parts when a plane has been so badly damaged that it cannot again be made serviceable.

Another item titled "United Nations vs. Axis Aircraft" gives the list of common types of land-based airplanes being used in this war, including those of the United Nations and the German Luftwaffe. It includes a tabulation showing the class of airplane and the names or type designations of the United Nations and German planes in current service in those classes. Italian and Japanese models are not included, but it is stated that the Japanese are using their own copies of older German Me 109 and twin-engined Me 110 and that Italian fighters are now being equipped with Daimler-Benz engines.

War Production Board

Here's How the New Aircraft Steel Warehousing Program Works. A bulletin of 6 pages gives information on the functions and activities of the Steel Division of the War Production Board and the details of an enlarged program for warehousing aircraft steel. The new plan contains four important changes intended to solve critical shortages and to forestall production delays caused by lack of material. The changes are as follows: (1) There has been an increase in the quantity of steels carried by the warehouses; this increase has been as much as five times the amount previously carried; (2) the amount of material that the warehouse may ship in a given period has been changed from a quarterly to a monthly basis; (3) aircraft manufacturers may issue blanket certificates to cover all future orders on warehouses; (4) the number of warehouses has been increased from 16 to 26.

A detailed explanation follows of the operations of the program, together with the list of warehouses and their locations, and a separate sheet carries a chart showing the flow of material through the official aircraft-steel warehouses.

State of Connecticut

Biennial Report of the Commissioner of Aeronautics. The eighth Biennial Report of the Connecticut Department of Aeronautics covering the period from July 1, 1940, to June 30, 1942, has been issued. Included in the pamphlet is the report of the Bureau of Personnel Inspection and of the Aircraft Mechanics Training Program at the State Trade School, as well as information on the number of pilot licenses issued and suspended, aircraft regulations, aircraft accidents, airports, state-owned aircraft, aircraft industries, and the Civil Air Patrol. *Connecticut Department of Aeronautics.*

British Information Services

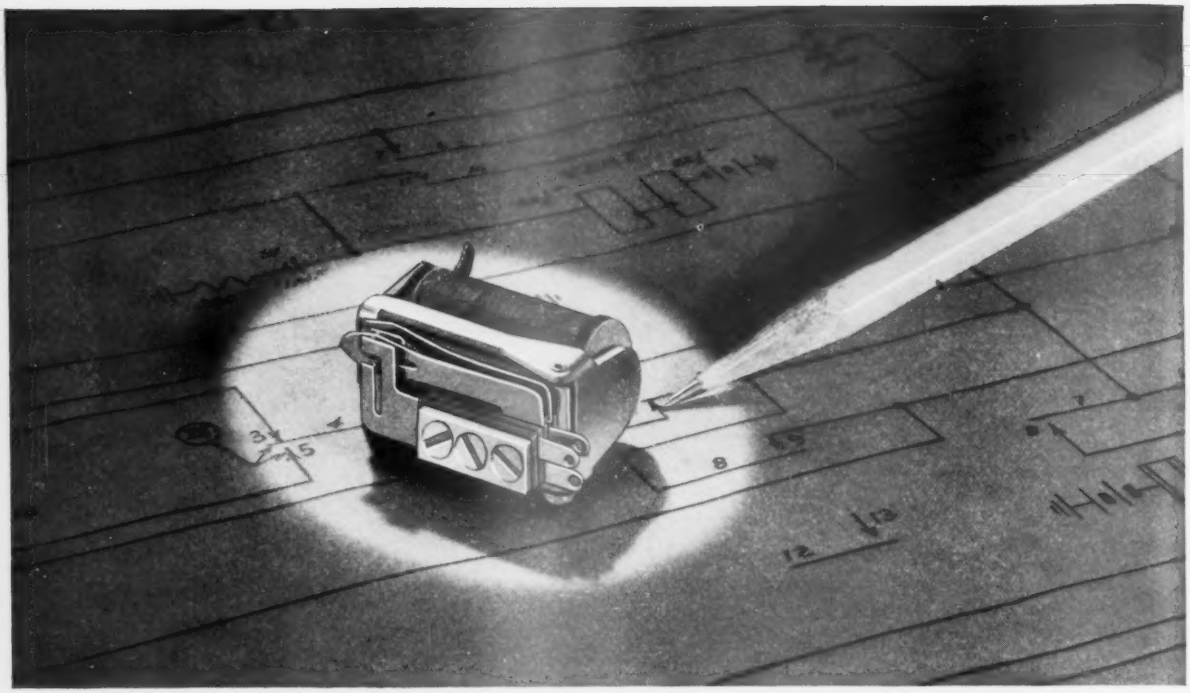
Notices (and List of New Translations Available) from the Scientific and Technical Press. A booklet of 48 pages gives extensive lists of articles in the technical and scientific press of the United States, Great Britain, and European countries. The subjects are classified under the various types of equipment to which they refer. Information given includes the title of the article, the writer, and references to the publication, its date, and page numbers. *Directorates of Scientific Research and Technical Development, Ministry of Aircraft Production.*

(*Continued from page 31*)

Conclusions

In actual practice a flight superintendent or meteorologist would make all calculations as outlined for determining all ground speeds. The basic information thereby obtained for climb, cruise, and descent air speeds is then sufficient to set up the analyzer. The pilot can then use his predeparture time in studying the atmospheric conditions shown on the analyzer. After considering all related factors of turbulence and other atmospheric conditions, as well as elapsed times of flight, the pilot can choose the most desirable flight altitude. After choosing the altitude, a flight plan can be copied down directly from the analyzer in a few minutes.

The present-day reduction of domestic schedules has decreased the utility of the altitude selector and flight plan analyzer. The necessity for instruments such as these, however, can reasonably be expected to increase with the addition of air-line and military schedules in meeting increased wartime transportation requirements.



BUILT SMALL TO TAKE A BIG BEATING!

A terrier shaking a rat is gentleness itself compared with the treatment an airplane gets in a power dive. The terrific vibration that sets up is enough to play hob with ordinary electrical equipment.

But Automatic Electric's new Class "S" Relays are made to take that sort of beating with a safe margin to spare. Especially designed for dependable use on the fastest modern aircraft, these tiny but powerful relays offer a combination of features never before found on any relay, large or small. For example:

1. With vibration resistance built-in, not "added on," the Class "S" Relay surpasses the most rigorous tests required by the Signal Corps and the Air Corps.
2. Its unique spring design provides high contact pressure within small space limits.
3. Its twin contacts provide further assurance of reliability.
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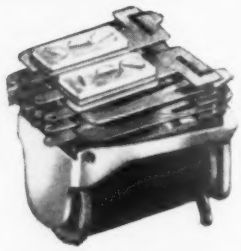
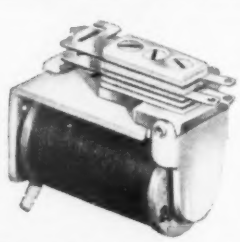


Class "S" Relay—Single Arm



Class "S" Relay—Double Arm

Class "S" Relays are available with a wide variety of coil and contact combinations and operate and release speeds. The single arm relay has a capacity of six contact springs—the double arm, twelve springs. Springs may be provided in any combination and arrangement of "break" "make" or "break-make" assemblies.

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BOOKS

Industrial Fire Brigades Training Manual

Edited by Emmett T. Cox, W. Fred Heisler, and Horatio Bond

Chapters

The Industrial Fire Brigade
Forcible Entry Practices
Rope Work
Fire Extinguisher Practices
Ladder Practices
Hose Practices
Salvage and Overhaul Practices
Fire Streams
Ventilation Practices
Periodic Inspections of Plant Fire Protection Equipment
Care of Fire Brigade Equipment
Fire Causes and Fire Hazards
Fire Fighting Procedure
Flammable Liquid and Gas Fires and Special Extinguishing Systems
Electrical Fires
Gas Masks and Rescue Practices

A training manual has been prepared by the Associate Director of the Indiana Fire Service Training Schools, the Associate Director of the School of Technical Training, Oklahoma Agricultural and Mechanical College, and the Chief Engineer of the National Fire Protection Association for organizations that maintain their own private fire brigades. It is designed primarily for use in classes where employees are assigned to carry out fire-fighting duties under the direction of the chief of the private brigade. It is not intended to be a manual on plant inspection, but material is included on periodic inspections and on fire hazards and causes.

The suggestions in the text are consistent with advice contained in other National Fire Protection Association publications and standards. Regular practice drills are necessary to maintain the efficiency of any fire brigade, and practice should be obtained with fire-fighting equipment so that actual experience and skill may be acquired. However, practice drills should not be relied on solely, and it is recommended that a training program for members of the brigade be established as laid out in this manual.

Maximum efficiency of a fire brigade depends not alone on drills and training classes for members but the brigade must be kept fully informed on all phases of fire prevention and fire extinguishment. To this end the authors advise that other books, pamphlets, and magazines be made available to the members of the organization. A large number of photographs and sketches contribute to an understanding of the text matter. National Fire Protection Association, Boston, 1943; 176 pages, $1.50.

Modern Aero Metalcraft Construction

A series of 40 lessons has been published in three volumes for the use of students of Aero Industries Technical Institute. It is intended to cover the theoretic part of the training course and can be used either in the classroom or at home. The work begins with a review of the history and development of the modern airplane and then covers, among other things, the organization of an aircraft factory, typical aircraft assembly practice, aircraft materials, and various processes for fabricating the parts of the air frame. Several lessons are devoted to subassembly practice. Other lessons give details of the machines used in aircraft factories, machine-shop tools and principles, and the construction of tools, dies, and instruments. The latter part of the third volume deals with the assembly of various parts, protective coatings and finishes, electrical and radial equipment and installation, power-plant and piping installation, final assembly operations, and miscellaneous shop practices. An index is supplied. References I, II, and III; Aero Industries Technical Institute, Los Angeles, Calif., 1942.

Aircraft Hydraulics

Harold W. Adams

Chapters

Flow of Fluids
Hydraulic Systems
Power System
Subsystems
Design Procedure
Design of Basic Units
Design of Special-Purpose Units
Hydraulic-Unit Design Procedure
Drafting of Aircraft Hydraulic Systems
Manufacture of Aircraft Hydraulic Units
Installation of Aircraft Hydraulic Systems
Testing Aircraft Hydraulic Units
Maintenance of Aircraft Hydraulic Systems
Index

The author has given special attention to the basic principles underlying the design of aircraft hydraulic systems. The particular method of presentation is followed in the belief that the vaerage American engineer, mechanic, or student wishes to know more than the simple details of systems in current use and arbitrary rules for their design. The course is intended to enable the student to understand present hydraulic systems and to take part in the development of future systems.

The principles of fluid flow are first covered, and the design of hydraulic systems is then discussed. The remainder of the book deals with drafting, manufacturing, installation, testing, and maintenance. McGraw-Hill Book Company, Inc., New York, 1943; 159 pages, $1.75.

The Struggle for Airways in Latin America

William A. M. Burden

Chapters

Latin America
Period of Development, 1920–34
Period of Expansion and Political Rivalry, 1935–39
Developments Since the Outbreak of the Second World War
The Basic Structure of the System
Operations of Pan American Airways, 1929–40
International Services by United States Companies
United States Air Transport Policy—Monopoly or Competition?
Future Development of Local Services

This encyclopedic study of air transport will remain for all time the classic reference book on the prewar development of air lines in Central and South America. It also ventures predictions as to postwar possibilities based on economic and industrial requirements.

The historical section traces the origin of each country's air lines and describes fully the German, Italian, and French efforts to establish their nationals and aircraft on many routes. A detailed account is given of the Pan American Airways and Panagra expansion toward the south. Maps and statistics supplement the text.

The increasing interest in South America on the part of European governments was reflected by the rapid growth

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ENGINE GROUND LEAD—ATTACH TO ENGINE OR SHIELDING.
TEST LEAD—ATTACH TO IGNITION LEAD FOR TEST.
USE PUSH BUTTON TO TEST. INPUT LIGHT OPERATES WITH PUSH BUTTON. OUTPUT LIGHT OPERATES IF THERE IS AN IRREGULARITY IN THE LEAD UNDER TEST.
EXERCISE CARE TO PREVENT FLASHING INSIDE MAGNETO IF BLOCKS ARE NOT REMOVED. DO NOT TEST UNLESS ALL SPARK PLUG LEADS ARE REMOVED FROM PLUGS.
DO NOT TOUCH OR COME IN CONTACT WITH TEST LEAD WHEN PUSH BUTTON IS PRESSED OR INPUT LIGHT IS ON.
SF9 MAGNETOS
TEST LEAD CYL. ON COMPR.
4-7 1
6-9 4
2-8 3
1 5
3 7
5 9
VAGDO MAGNETOS
TEST LEAD CYL. ON COMPR.
2-4-7-9 3
1-3-5-8-6 8
FOR MAGNETOS NOT LISTED REMOVE DISTRIBUTOR BLOCK.
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Model M-564 AC 110V-25 Cycle
Model M-581 AC 220V-60 Cycle

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of internal air lines operated by subsidy and the direct connection with Europe by transatlantic air lines. At the same time, a wave of nationalism swept over the whole continent, transferring control of practically all air transport operations within a country's borders to its local control, both financial and operational.

The developments since the Second World War lead to a description of the basic structure of the present system. The possibilities of passenger, mail, and express traffic are given, using past experience as an index. Comparisons are made with United States and European operations as to costs, miles flown, accident rate, and equipment.

Having laid such an exceptionally broad groundwork, the author gives the present attitude of the C.A.B. toward competition in the field, when conditions permit, and makes predictions as to the extent of the influence of air transport on Latin America's future.

A statistical appendix contains comparative tables covering all phases of the operations of the air lines mentioned in the book.

Those who are interested in postwar international problems relating to air transport and who have idealistic ideas as to the ease with which airplanes can roam the skies of the world will find a practical situation to overcome in Latin America. It is described fully by Mr. Burden. Council on Foreign Relations, New York, 1943; 245 pages, $5.00.

America's Fighting Planes in Action

Reed Kinert

Chapters

Military Aircraft Markings
Beechcraft GB-1
Beechcraft F-2, AT-11, JRB-1 & AT-10
Boeing AT-15
Airacobra Bell P-39
Buffalo Brewster F2A
Avenger Grumman TBF
Buccaneer Brewster SB2A
Bobcat Cessna AT-17
Blimp Goodyear Type K
Cadet Culver PQ-8
Catalina Consolidated PBY
Commando Curtiss C-46
Constellation Lockheed C-69
Coronado Consolidated PB2Y
Cornell Fairchild PT-26
Corsair Vought F4U
Curtiss AT-9
Dauntless Douglas SBD
Excalibur Sikorsky JRS
Fairchild PT-19
Fairchild AT-13 & 14
Flying Fortress Boeing B-17
Forward Fairchild C-61
Fleetwings BT-12
Falcon Curtiss SNC
Gliders
Grasshoppers Taylorcraft L-2
Cub Piper L-4

Books reviewed in this section may be borrowed without charge from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Defender Aeronca L-3
Harvard North American AT-6
Helldiver Curtiss SB2C
Havoc Douglas A-20

Pictures of American military planes in action and accompanying descriptions covering important characteristics of the planes are contained in this book. The author, who is also the artist, is a primary instructor at Ryan Field, Calif., and therefore has both a personal interest in the subject and the necessary qualifications for writing and illustrating a book of this kind.

United States military aircraft now in production or in quantity use are shown. The order in which the planes appear in the book has no relation to their importance in the Air Forces, since they are arranged in as near to alphabetical order as the layout of color printing allows. The Macmillan Company, New York, 1943; 144 pages, $2.50.

Physiology in Aviation

Chalmers L. Gemmill

Chapters

Physiology Applied to Aviation
Historical Introduction
The Air
The Gas Laws and Their Application
Mechanics of Respiration
Alveolar Air
The Carriage of Oxygen by the Blood
The Carrying Capacity of the Blood for Carbon Dioxide
The Control of Respiration
The Acute Effects of Anoxia
The Use of Oxygen in Aviation
The Chronic Effects of Altitude
Aeroembolism
The Circulation
The Control of Circulation
The Effects of Acceleration on Man
The Temperature Control of the Body
The Physiology of Muscular Exercise
Instrument Flight, by Lieutenant Frederick B. Lee, A-V (T), U.S.N.R.

A practical handbook on physiology as applied to aviation is based on a series of lectures on physiology given in the School of Aviation Medicine of the Naval Air Station at Pensacola, Fla. It is intended to be of interest to aviators who must realize that it is just as important to study the man in the plane as it is to know the characteristics of the plane. The author is a Commander in the Medical Corps of the United States Naval Reserve. Charles C. Thomas, Baltimore, Springfield, Ill., 1943; 129 pages, $2.00.

Physics Manual for Pilots

Chapters

Forms of Matter
Units
Fluids at Rest; Hydrostatics
Fluids in Motion
Heat
Atmospheric Humidity
Balanced Forces and Torques
Work—Power—Horsepower
Friction
Properties of Materials
Uniformly Accelerated Motion
Motion and Forces
Energy
Uniform Circular Motion
Gyroscopes
Magnetism
Electricity
Sound and Light
Answers to Problems

The fundamental principles of physics are given in a manual for pilots who are studying aerology, the theory of flight, and engine operation. Because for many students the manual will be the first contact with the science of physics, the author has used simple, easily understood language in conveying the subject.

Material not considered essential to a pilot's training is omitted. In order to permit review courses in mathematics and physics to run concurrently, those portions of physics involving the least amount of mathematical skill are taken up first, wherever possible. McGraw-Hill Book Company, Inc., New York, 1943; 229 pages, $0.90.

I Seek My Prey in the Waters

Squadron-Leader Tom Dudley-Gordon

Under one nom de plume three R.A.F. officers tell the story of the British Coastal Command. From their personal contact with, and observation of, the events that transpired, they record the activities of that part of the Royal Air Force responsible for the safeguarding and convoying of all shipping to and from Great Britain. The history follows the Command through the many coastal lines over which it has ranged . . . telling of its operations since the beginning of the war from the coasts of England, Holland, Belgium, France, and Norway to those of Iceland, Africa,

"PERISCOPE ON THE STARBOARD QUARTER!"

IN SUBMARINE-infested waters, a speeding destroyer must be able to change its course in a split-second—to drop its deadly ashcans on enemy U-boats.

The secret of the destroyer's great *speed* and *maneuverability* is the tremendous power of its turbines, operating at steam temperatures *high enough to make the turbine blades glow!*

This introduces a difficult problem in turbine construction. The highly heated metal parts "creep" under stress. The metallic grains slowly slide over each other. The metal tends to *flow* out of shape.

Excessive "creep" would quickly destroy the turbine—due to collision between the blades and other parts of the turbine, which are spaced only a *fraction of an inch apart* for maximum power.

Westinghouse first introduced the steam turbine in the United States and has built thousands during the past 45 years. And much of the success of Westinghouse steam turbines is due to the intensive study of "creep" by scientists in the Westinghouse Research Laboratories.

As a result of the "know how" gained through this research, the "creep" in some turbine metals has been reduced to 1/10,000th of an inch per inch per year—less than 1/64th inch per inch in 100 years.

This has guided the development of metals capable of operating at greatly increased temperatures and speeds—and secured *more power per pound of turbine*, a vital necessity in a destroyer!

Westinghouse Electric & Manufacturing Co., Pittsburgh, Penn.

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and Russia. It depicts the vital role played by the Command in the "Battle of the Atlantic" and describes in detail individual events that exemplify the work of this branch of the R.A.F. Such events include the sinking of the "Bismarck," the surrender of a U-Boat to a Lockheed Hudson, and the return of the British Army from Dunkirk.

The book also surveys the organization of the Coastal Command, its methods of operating, its personnel, and the men in charge of it. Special note is made of the cooperation with the Navy and the Merchant Service. Doubleday, Doran & Company, Inc., Garden City, New York, 1943; 297 pages, $3.00.

Mathematics for the Sheet Metal Worker

Clayton E. Buell

Chapters

Common Fractions and Decimals
Layout of Angles, Lines, and Figures
Use of Formulas
Measurement of Lengths
Bend Allowance
Measurement of Areas and Weights
Measurement of Surface Area and Volume
Graphs
Template Development From Tables
Shop Trigonometry
Bend Allowance by Set-Back Method
Measurement of Irregular Areas and Volumes
Strength of Materials
Ventilation of Compartments

A practical applied mathematics book is offered for sheet metal workers in the aircraft and other industries. It is intended for use either as a text for classes in vocational schools, apprentice schools, male- and female-helper trainee schools, and evening schools or for individuals interested in obtaining a sound background of trade mathematics by means of home study.

The material has been arranged so as to be easily learned and there is a simple and practical approach to each new idea. The mathematics is not of the formal type but is that which arises from shop problems and blueprints. All of the important branches of mathematics required by the regular shopworker are included and also some advanced work for the more serious student. The author is an instructor of related trade mathematics, science, and drawing at the Apprentice School of the United States Navy Yard at Philadelphia, and the Edward Bok Vocational School, Philadelphia. Pitman Publishing Corporation, New York, 1943; 199 pages, $2.00.

The Story of Weapons and Tactics

Tom Wintringham

Although this book does not contain much about airplanes, it does emphasize the resistance to change in methods of warfare since the earliest days. It gives background material and very interesting facts for any talk or discussion of the probable military future of aircraft.

Anyone reading the record of the pioneering that had to be done to change static hand-to-hand fighting with bows and arrows, to gunpowder devices, and then to machine guns will know how difficult the introduction of the airplane as an instrument of warfare has been. No better book could be found for securing an understanding of the slowness of changes in military arms than this historical study. Houghton Mifflin Company, Boston, 1943; 230 pages, $2.25.

Introductory Artillery Mathematics and Antiaircraft Mathematics

Sophia H. Levy

Chapters

Algebra, Geometry, Trigonometry, Coordinates in Two Dimensions
Coordinates in Three Dimensions (Terrestrial and Celestial), Determination of True North
Logarithmic Scales, Slide Rules, Including the Crichlow Slide Rule, and Solutions of Triangles Using Slide Rules and Using Logarithms
Motion of a Projectile, the Trial Shot Problem, Lateral Deviations in Slant and Horizontal Planes
Solutions of Triangles of the Trial Shot Problem Using Slide Rules and Using Logarithms
Graphical Solutions of the Trial Shot Problem
Summary of Directions for Solutions of Triangles and the Trial Shot Problem

Tables—Conversion Tables for Angles and Lengths, Four-Place Tables of Natural Trigonometric Functions, Logarithms of Numbers, and Logarithms of the Trigonometric Functions for Angles in Mils

The author offers a book dealing with those parts of mathematics essential to men in the armed services of the United States and written primarily for those engaged in antiaircraft service. Emphasis is placed on the trial shot problem. Descriptions of slide rules are included, and tables, a protractor, and a two-part transparent slide rule are provided at the back of the book. Only type problems are given and all are solved completely. The author is Associate Professor of Mathematics at the University of California. University of California Press, Berkeley, Calif., 1943; 100 pages, $2.50.

Mathematics for Pilots

Chapters

Fundamental Operations
Conversion Factors
Fractions
Percentage
Powers and Roots
Angular Measurement
Vectors
Equations
Variation
Graphs
Geometry
Trigonometry
Appendix
Answers for Exercises

Those fundamentals of mathematics which the pilot requires in order to solve navigation problems quickly and accurately and to understand simple formulas used in discussions on the principles of flying are covered in this book.

The book is one of a "Flight Preparation Training Series" published under the supervision of the Training Division of the Bureau of Aeronautics, United States Navy. McGraw-Hill Book Company, Inc., New York, 1943; 157 pages, $0.75.

The Art of Camouflage

Lt. Col. C. H. R. Chesney

Chapters

Camouflage in Nature: General Resemblance
Camouflage in Nature: Special Resemblance
Civil Camouflage: General Considerations
The Story of Camouflage in the War 1914–18
Civil Camouflage, Now and in the Future
Military Camouflage in the Future
Napoleon
Stonewall Jackson
The Boer War
The War 1914–18

The subject of camouflage is discussed in simple language, technical details being reduced to suggestions that technical experts, engineers and architects may work out for themselves. The book is divided into three sections, the first of which is devoted to a study of natural camouflage—that is, Nature's methods of camouflage—illustrated examples being protective coloring in the woodcock and protective resemblance of the Lappet moth. It is emphasized the subject of camouflage does not involve coloration alone but also has to do with a complex series of problems. Man's first serious effort, consistently maintained over a number of years, to apply

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The keeper of the light which guides a great air transport to land has no wick or trim...no lens to polish. He's a radio engineer and his beacon is much more certain than a ship's lamp.

Radio communications, instrument landing and other (now secret) equipment are perhaps the most important adjunct to air travel. As vital to man's flight as the spark plugs in the motors, the ailerons or the rudder.

Electronic vacuum tubes are the heart and soul of these electronic devices which are so closely bound to the conquest of the air. And Eimac tubes in particular have played a leading role in aircraft communications . . . in the key sockets of the ground stations of every major airline, in instrument landing and today in the secret military equipment for aircraft. Remember these facts while you lay post war plans for mastery of the air.

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the lessons learned from Nature in a setting requiring special adaptation of those lessons is the subject discussed in the second part of the book. The third section deals with an aspect of camouflage divorced from all material objects —the struggle of mind against mind. The author discusses strategic camouflage or the camouflage of military intention. The Studio Publications, Inc., New York, 1943; 252 pages, $2.75.

War Eagles

James Saxon Childers

This book is a recital of the high spirits and the achievements of that group of young Americans who could not wait for the entrance of their own country into the war but started to bring air warfare to the enemy by joining the Royal Air Force. Their pranks and mischievous behavior and their seemingly reckless attitude were, at first, amazing to their more conservative British comrades and later aroused their whole-hearted admiration. Among other anecdotes, it is told how, when they were grounded by bad weather and became bored with the monotony, they raided an arsenal and, without invitation, joined in the maneuvers of an infantry group, transgressing many of the laws of warfare but having a good time for themselves.

There can be no doubt that they were good soldiers, but, being high-spirited young adventurers, there were many incidents when they were not strictly amenable to discipline, and their escapades occupy a large part of the book.

The illustrations, consisting of photographs and drawings, include diagrams of aerial combats. D. Appleton-Century Company, Inc., New York, 1943; 350 pages, $3.75.

Combat Aviation

Keith Ayling

Chapters

Planes and Men
Formations
Large Formations
Single Combat
Gunnery
Interception
Night Interception
Ground Support
Old Masters and New
Recognition

A book on combat flying is offered as a guide to fighter pilots and to aid those expecting to take up operational aviation. The book covers the fundamentals of combat flying and contains many examples of modern techniques.

The text has been written in a non-technical style in order to make the information furnished understandable to the general public and to writers and radio commentators who may have to discuss aviation in connection with their work. The author was a Royal Air Force operational pilot and, since 1921, has been flying, writing, and lecturing about flying. Military Service Publishing Company, Harrisburg, Pa., 1943; 253 pages, $2.00.

Mathematics of Air and Marine Navigation

A. D. Bradley

Chapters

Geometry of the Earth
The Sailings and Dead Reckoning
Piloting
Special Problems of Air Navigation
Spherical Trigonometry of the Earth
Nautical Astronomy
Celestial Navigation; The Sumner Line

In writing this book the author's object was to provide the future navigator with a substantial foundation of mathematical theory and to acquaint the interested layman with problems encountered in navigating.

In the section on applied trigonometry the author has avoided burdening the student with unnecessary formulas and furnishing too many cases of triangle solutions. The use of haversines simplifies both formulas and computations. Five-place tables are provided for the solution of numerical problems. Many of the problems are solved with graphic construction. The treatment is direct and concrete, and the numerous diagrams are intended to make the explanations easy to follow. American Book Company, New York, 1942; 103 pages, $1.00.

Book Notes

An Aeronautical Reference Library, compiled by Willard Kelso Dennis; Special Libraries Association, New York, 1943; 31 pages, $1.10.

A selected list of technical books suitable for aeronautical libraries. The publication is the result of the cooperative effort of 18 librarians working in this field. It contains a basic list of approximately 800 titles for an aeronautical library which can be purchased at a cost of $2,600. The name and address of the publisher and the price of each volume are included as a buying guide.

Warships and Aircraft of Japan; Hutchinson & Company, Ltd., London, England, 1942; 64 pages, 1*s.* 3*d.*

This booklet contains a representative collection of photographs of Japanese warships and aircraft, together with a detailed description of each, insofar as particulars are available.

Army Selectee's Handbook, by Lt. John R. Craf; Stanford University Press, Stanford University, California, 79 pages, $0.75.

A guide for young men entering the armed forces is offered in the form of a handbook. The primary purpose of the book is to provide basic orientation and to serve as a guide during the first several weeks of military training. Information is given on the planning of an Army career, induction, the reception center, military discipline, customs and duties, replacement training centers, officer candidate schools, and the American soldier at home and abroad.

Technical Lettering by E. Paul De Garmo and Finn Jonassen; The Macmillan Company, New York, 1943; 20 pages, $1.00.

In this course on technical letter writing a system of vertical, single-stroke, free-hand lettering is described which is claimed to be easy to acquire, rapid in its execution, clear, and useful in actual drafting practice. The type and size of the letters used will satisfy the majority of engineering drawing requirements. The lettering is intended to be done in either pencil or ink. The assignments are printed on tracing paper so that the student will become accustomed to working with that kind of paper.

Try-Out in Spain, by Cedric Salter; Harper & Brothers, New York, N.Y., 1943; 291 pages, $2.50.

A British correspondent gives his experiences on the fighting fronts of the Spanish Civil War. Prominent in his report of the three-year conflict is his account of how the civilian population was affected by the war and what they suffered at the hands of German and Italian troops. The book is presented as a vivid forecast of the events that later swept the entire continent of Europe.

Airline Public Relations Activities, by John H. Frederick and Geneva Rooth; John H. Frederick and Geneva Rooth, Austin, Tex., 1943; 42 pages, $1.00.

The public relations activities of air lines and the work of public relations departments are discussed. One section of the book is devoted to the Civil Aeronautics Board and air-line public relations.

Student Pilot Handbook, by Jack Hunt and Ray Fahringer; Books, Inc., New York, 1943; 251 pages, $2.50.

A handbook for student pilots which combines the written knowledge and rules of airplane flight with visual aids for interpreting and learning them. It explains not only what to do in learning to fly but why and how in words and pictures. This volume for primary flight training contains over 400 illustrations by a well-known cartoonist. Both of the authors have had many years of background in civilian aviation and are now members of the Army Air Forces.

Cugle's Practical Navigation, by Capt. Charles H. Cugle, and revised by Lt. Comdr. I. J. Stephens; E. P. Dutton & Co., Inc., New York, 1943; 736 pages, $7.00.

This book covers rules, problems in navigation used in everyday work at sea, and short definitions of the theory of navigation, together with other useful information for master mariners, naval officers, steamship lines, and yachtsmen.

The original purpose of the author, to write a textbook that would embrace the practical elements of the subject in such a manner that a knowledge of the theory would not be essential, has been maintained.

Certain chapters have been extensively revised and others rewritten; a new chapter on Time has been included, and problems have been reworked to bring them up to 1943 standards, with consideration of recent changes in solution procedure. New chapters have been formed from the Addenda of the 1942 edition and the original material has been amplified. Extracts from the *American Nautical Almanac* for 1943, printed in the back part of the book, are intended to enable the student to follow all problems covered.

Air Navigation, by Comdr. P. V. H. Weems; McGraw-Hill Book Company, Inc., New York, 1943; 406 pages, $4.50.

In addition to covering the commonly used methods of piloting and dead reckoning, this revised third edition on avigation stresses the importance of position finding by means of celestial observation and by means of radio bearings. In order to make the text as suitable as possible for practical navigation under war conditions, material on civil airways and other phases of air navigation, which would have been treated more fully under normal conditions, have been reduced or omitted.

Aircraft Mathematics, by S. A. Walling and J. C. Hill; The Macmillan Company, New York, 1943; 186 pages, $1.75

A book on mathematics for men entering the various branches of the air services is offered in revised form. It is intended to provide pilots, navigators, bombardiers, and mechanics with a means for quickly reviewing elementary mathematics. The scope of the book is from simple arithmetic through trigonometry. There are 590 problems with answers for self-checking. The new edition has been remodeled so that essential material is more readily accessible to the student.

A.S.T.M. Standards on Plastics; American Society for Testing Materials, Philadelphia, Pa., 1943; 375 pages, $2.00.

The first edition of this new A.S.T.M. publication contains 71 specifications, methods of tests, and definitions as developed by committees on plastics and on electrical insulating materials. It gives, in a single publication, material considered of importance to those concerned with plastics. Thirty of the standards have been developed by the committee on plastics that includes many of the country's leading technical authorities. For several years the committee concentrated on establishing satisfactory methods of tests and improving upon those in use and, more recently, it has intensified its work in drafting purchase specifications. Over 20 of the items included in the publication have been developed as a result of committee work in the field of electrical insulating materials.

Several kinds of molding compounds are covered by standardized specifications: phenolic; polystyrene; melamine-formaldehyde; urea-formaldehyde; cellulose acetate; cellulose acetate butyrate; also, sheets, rods, etc., of cellulose nitrate; cast methacrylate, and vinyl chloride-acetate resin sheets. Phenolic laminated sheet and phenolic laminated tubing for radio applications are also included.

The large number of standard test procedures essential in determining various properties of plastics cover such matters as the following: arc resistance, resistance to chemical reagents, color fastness, compressive strength, relative humidity, deformation, distortion, dielectric constant, diffusion of light, flammability, flexural strength, flow temperatures, haze, impact resistance, mar resistance, punching quality, refractive index, surface irregularities, shrinkage, softening point, tensile properties, tear resistance, thermal conductivities, water absorption, etc.

A descriptive nomenclature is included, and there are various sets of definitions of terms on subjects of interest in the plastics field

National Emergency Steels; The American Society for Metals, Cleveland, O., 1943; 72 pages, $0.50.

A pamphlet on the National Emergency Steels, prepared largely from material first published in *Metal Progress* to aid the numerous War Production Advisory Committees. It contains brief articles on the various grades of steel and on such properties as weldability and hardenability. Numerous tables and charts give technical information on this group of special steels.

College Physics Abridged, Revised Edition, by Henry A. Perkins; Prentice-Hall, Inc., New York, 1943; 593 pages, $6.00.

A course in physics for college students is offered in revised form. The explanations of principles and theoretic deductions are so written that the student should be able to understand them without the assistance of the instructor. This is intended to give the instructor more time to enlarge on the text, discuss practical applications, and perform experiments. In the new edition the treatment of harmonic motion has been simplified and proof of the lens equation has been made easier. Dimensional formulas have been eliminated.

Gun Care and Repair, by Charles Edward Chapel; Coward-McCann, Inc., New York, N.Y., 1943; 454 pages, $3.75.

This is a manual on the maintenance, repair, alteration, and decoration of rifles, pistols, revolvers, and shotguns. Gunsmithing processes are explained, together with the choice of tools, woods, metals, and chemicals. The text covers stock designing, blueprint reading, checkering and carving stocks, modernizing obsolete weapons, hand-forging and heat-treatment, trigger problems, and minor repairs and adjustments. It also includes the fitting of sights, blueing, browning, checking head-space, obtaining employment as a gunsmith, and opportunities for Government service careers in this field.

Wartime Refresher in Fundamental Mathematics, by Lt. W. C. Eddy, U.S.N. (Ret.), A. H. Brolly, Ens. E. S. Pulliam, E. C. Upton, G. W. Thomas; Prentice-Hall, Inc., New York, 1943; 247 pages, $1.40.

Basic principles of mathematics are given in a refresher course for those entering various branches of the armed services. The course can be completed at home by an hour of self-study every day for 24 days. The individual chapters have been arranged to move from simple arithmetic to complex algebra. Each day's problems are followed by a cue sheet giving hints about setting up and solving the more difficult problems, and this cue sheet is followed by the solutions to all the problems. At the end of every five days, a review of the work is given to crystallize what has been learned during the preceding days.

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BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

There's Something in the Air, by Flying Officer X (H. E. Bates); Alfred A. Knopf, New York, 1943; 172 pages, $2.00.

The author of this book gave it the title "The Greatest People in the World" and a quarter of a million copies were sold in England before publication. He tactfully changed the title for the American edition.

It is becoming increasingly apparent that English writers on aviation like to use R.A.F. slang. The reader, having been mystified by some of the slang expressions, finds a small glossary at the end of the book, but not soon enough to be of much help.

Each chapter is the story of some pilot or event, so that the book may be read with interruptions since it has no continuity. It will give an insight into the life, philosophy, and courage of R.A.F. pilots and their friends and families. The author, a skilled short-story writer, has also written many books. He was commissioned as Flying Officer X by the British Government to study men of the R.A.F. in and out of action. The 21 stories tell of the work of the bombing squadrons that are doing such remarkably effective work from bases in England.

Remember Pearl Harbor, by Blake Clark; Harper & Brothers, New York, N.Y., 1943; 300 pages, $2.50.

An eyewitness, human-interest report of the attack on Pearl Harbor is presented. Incidents and information that were omitted from the first edition of this book because of their military value are included in this amplified version. The added material includes an account of the actual damage done to each ship sunk at Pearl Harbor (the "California," the "Nevada," the "Vestal," the "Solace," and others) and the story of Bellows Field and that of the 32 men trapped for two days in the sealed hull of the "Oklahoma."

The illustrations include some dramatic photographs of explosions on land and on ships, fires, and the damage to property.

The Gremlins, by Flight Lt. Roald Dahl; Random House, New York, 1943; 48 pages, $1.00.

This is the book upon which a motion picture by Walt Disney is based. It tells the story of how the R.A.F. became acquainted with gremlins. Amusing line sketches and colorful drawings illustrate the account of the gremlins, the fifinellas (female gremlins), the widgets (baby gremlins), and their antics.

The Story of Flying, by Archibald Black; Whittlesey House, McGraw-Hill Book Company, Inc., New York, N.Y., 1943; 272 pages, $2.50.

This new edition brings the record up to recent events in the present war in the air. The author has had an excellent opportunity to evaluate achievements and writes the narrative of the beginnings and development of human flight with a background of experience and the benefit of comments on the earlier volumes.

Few books on the history of aviation give a clearer account of the procession of events that have made aeronautics a predominant influence in world affairs.

Queens Die Proudly, by W. L. White; Harcourt, Brace and Company, New York, 1943; 273 pages, $2.50.

An account of the first South Pacific Air Campaign is woven from the personal narratives of Col. Frank Kurtz and the crew of the Flying Fortress "Swoose."

The book tells how a few airmen, fighting against great odds in a pitifully inadequate number of Flying Fortresses, struck back at the Japanese in the Philippines, Borneo, Java, and Australia. Its eyewitness, reportorial style imparts a vividness to the picture of heroism and courage.

He's in the Coast Guard Now, by Henry Felsen; Robert M. McBride & Company, New York, 1943; 199 pages, $2.50.

The manifold activities of the U.S. Coast Guard are surveyed, the history of the service is reviewed, and pertinent information is offered for those who wish to join the Coast Guard. Outlining the shore and sea duties of a Coast Guardsman in war and peacetime, the author depicts the experiences of a Guardsman from the time he enters training until he is serving on a front that extends to any corner of the globe.

A chapter is devoted to Coast Guard aviation, which reviews the history of the air branch and tells of its accomplishments. Figures are given on a single year's work of the aviation unit.

Combined Operations; The Macmillan Company, New York, 1943; 155 pages, $2.00.

Supplemented with a foreword by their chief, Lord Louis Mountbatten, this is the official story of the Commandos. Their activities are recounted from the first experimental attacks on Norwegian islands to the invasion of North Africa. The book describes how selected men from the Royal Navy, the British Army, and the Royal Air Force worked together under the directions of Combined Operations to wage amphibious warfare along scattered enemy coasts. It considers their methods, their training, their equipment, their purpose, and their accomplishments.

The Problems of Lasting Peace, by Herbert Hoover and Hugh Gibson; Doubleday, Doran and Company, Inc., Garden City, N.Y., 1943; 303 pages, $2.00.

This is a revised edition of a book that reviews the historical forces of war and peace and suggests the foundations for a peace which may be maintained. In addition to revising several passages for greater clarity and numbering their 50 italicized conclusions, the authors have rewritten their chapter on the method of negotiating lasting peace. They state that they do not propose a prolonged armistice but, on the contrary, advocate eliminating the armistice period altogether through a quick provisional peace with a cooling-off period for determination of economic reforms and the machinery for preserving such peace.

In addition to urging that postwar plans be undertaken at once, the book offers alternative plans for preserving the peace and outlines the methods by which the work of making peace should be conducted.

Field of Action of Aircraft, by W. W. Smith; Jardur Import Company, New York, 1943; 36 pages, $1.50.

A book on aerial navigation based on a new method of solving radius of action problems is offered for pilots and navigators. The simplicity of the method is claimed to be such that under any given set of conditions a determination can be made for all directions of flight from the base in a few minutes. This total determination is called the "field of action." The book contains eleven demonstrations and 19 problems. It is stated that the principles demonstrated can be applied to many additional problems.

U. S. Armed Forces, by B. Stones; Authentic Publications Company, New York, 1942; 64 pages, $0.25.

This guide furnishes information on the organization, training, rates of pay, and opportunities for advancement in all the armed forces of the United States. It describes their functions in actual combat and behind the lines.

Trees and Test Tubes, by Charles Morrow Wilson; Henry Holt and Company, New York, 1943; 352 pages, $3.50.

A realistic survey of the rubber situation is presented by a man who has lived on an experimental rubber plantation in Central America. The economic, political, and physical aspects of rubber cultivation are discussed, and the work of the pioneers of the modern rubber industry, including Charles Goodyear in particular, is described. The extent to which civilization of today has become dependent on rubber is emphasized. The devel-

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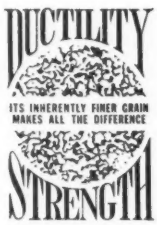

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THERMOSETS						
RESINOX phenolic compounds — IMPACT	5,500 8,000	0.8 8.0	230	GOOD TO EXCELLENT	EXCELLENT	LIMITED TO DARKER OPAQUES
RESINOX phenolic compounds — ELECTRICAL	4,200 8,000	0.22 0.72	450	GOOD TO EXCELLENT	EXCELLENT	LIMITED TO DARKER OPAQUES
RESINOX phenolic compounds — GENERAL PURPOSE	5,000 8,000	0.2 0.40	250	GOOD TO EXCELLENT	EXCELLENT	LIMITED TO DARKER OPAQUES
MELAMINE melamine compounds — GENERAL PURPOSE	6,000 10,000	0.28	210	GOOD TO EXCELLENT	EXCELLENT	ALL SHADES TRANSLUCENT TO OPAQUE
MELAMINE melamine compounds — ELECTRICAL	5,500 7,000	0.28 0.40	300 380	GOOD TO EXCELLENT	EXCELLENT	UNLIMITED OPAQUE

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opment of synthetic rubbers, which are more accurately termed substitute rubbers or elastomers, is outlined in considerable detail. The book is based on both the personal knowledge and the careful research of the author.

Some Aspects of Dynamic Anticyclogenesis, by H. Wexler; The University of Chicago Institute of Meteorology, Chicago, 1943; Miscellaneous Report No. 8, 28 pages.

This paper is one of a series of reports dealing with various aspects of meteorology. It is devoted to the dynamic type of anticyclone or the "warm" anticyclone, as distinguished from the polar anticyclone. The dynamic anticyclone is defined as a deep circulation composed of warm tropospheric air, commonly found over various regions to the south of the westerlies.

The first part discusses the reverse circulation cell and anticyclogenesis, perturbations in the westerlies, and anticyclonic cells. The second section covers surface conditions and dynamic anticyclogenesis. The consideration being divided into three main types of shielding layers: The first of these is the subsiding wedge of polar continental air; the second, the shielding effect of the Great Basin; and the third, local cooling over large areas.

Ocean Analysis from Coastal Reports, by H. Riehl and C. Robert Elford; The University of Chicago Institute of Meteorology, Chicago, 1943; Miscellaneous Reports No. 9, 18 pages.

A project was undertaken by the University of Chicago's Institute of Meteorology to extend the technique forecasting from local data, in the absence of reports from ships during wartime, in order to provide a means of analyzing the weather over oceans from coastal observations only. The method outlined can be utilized to obtain weather estimates and forecasts of a general nature over any ocean area of the middle and high latitudes for which aerologic data from adjacent shores are available. It is intended to be particularly useful in the North Atlantic Ocean.

The method of reconstructing the weather conditions over the ocean from shore data is illustrated by the analysis of two different weather situations over the northeast Pacific Ocean, using reports from the Pacific Coast, Alaska, and Honolulu only.

The first case comprises a review of the synoptic conditions of the West Coast, central and western Alaska, Honolulu, and the central Pacific area. The synoptic charts are then reconstructed.

The second case is developed in a similar manner and the two situations are compared. Several weather maps are included.

Military French, by François Denoeu; D. C. Heath and Company, Boston, Mass., 1943; 355 pages, $1.75.

A textbook on military French is offered for academic and military students who wish to acquire the vocabulary needed by liaison and intelligence officers and to learn the essentials of French grammar.

Each of the 42 lessons is composed of a presentation or review of essential grammar; a word-and-idiom list on one aspect of military life, to be used for reference rather than systematic memory work; a two- or three-page story of intermediate difficulty; and questionnaires and grammatic exercises.

Essentials of Drafting, by Carl Lars Svensen; D. Van Nostrand Company, Inc., New York, 1943; 295 pages, $2.35.

The entire text of this book on the basic principles of drafting and their application has been rewritten and rearranged to bring it in line with the best current practice. The book is a direct treatment of the subject intended for those who are making and reading drawings. New illustrations and problems have been incorporated in the revised edition.

The Gremlins of Lieut. Oggins, by Irwin Shapiro; Julian Messner, Inc., New York, 1943; 40 pages, $1.50.

In humorous verse the story is told of what happened to an American Air Forces Lieutenant who did not believe in gremlins. Line drawings of gremlins and their antics illustrate the tale of how he was converted to belief.

Standard Aircraft Worker's Manual, Fletcher Aircraft Training System, Burbank, Calif., 1941; $1.50.

A new pocket edition, the seventh, of the *Standard Aircraft Worker's Manual* has been issued. The manual is intended for the mechanic engaged in building all-metal planes.

The fundamentals of aircraft construction, aluminum and its alloys, aircraft steel, assembly, riveting and installation, the care and use of tools, shop plane geometry, sketching and dimensioning, and blueprints are included.

One section is devoted to tables, charts, and formulas.

Electrical Counting, by W. B. Lewis; The Macmillan Company, New York, 1943; 144 pages, $2.50.

A book is offered on the technique of electrical counting as applied to the counting of alpha and beta particles. The book is devoted exclusively to the observation of a trail of ions caused by electrically charged atomic and subatomic particles passing through matter, by means of its electrical effect. The method is recognized as a most effective means for the rapid accumulation of data for exact energy measurements.

The portion beginning with Chapter III should be of particular value to those who are not concerned with nuclear physics but who have occasion to use valve circuits. The technique of electrical counting has become an essential aid in research in nuclear physics and this book represents the work of the author aided by his associates in the Cavendish Laboratories.

Library Accessories

In addition to books reviewed and noted, the following were also received:

Elementary Aeronautical Books; Library of Congress, Division of Aeronautics, Washington, D.C., September 10, 1942; 13 pages, mimeographed, free.

A revision of the list published November 21, 1941, adding new titles and eliminating others. About 172 books are listed under some twenty-two subjects, and the prices of the books are given.

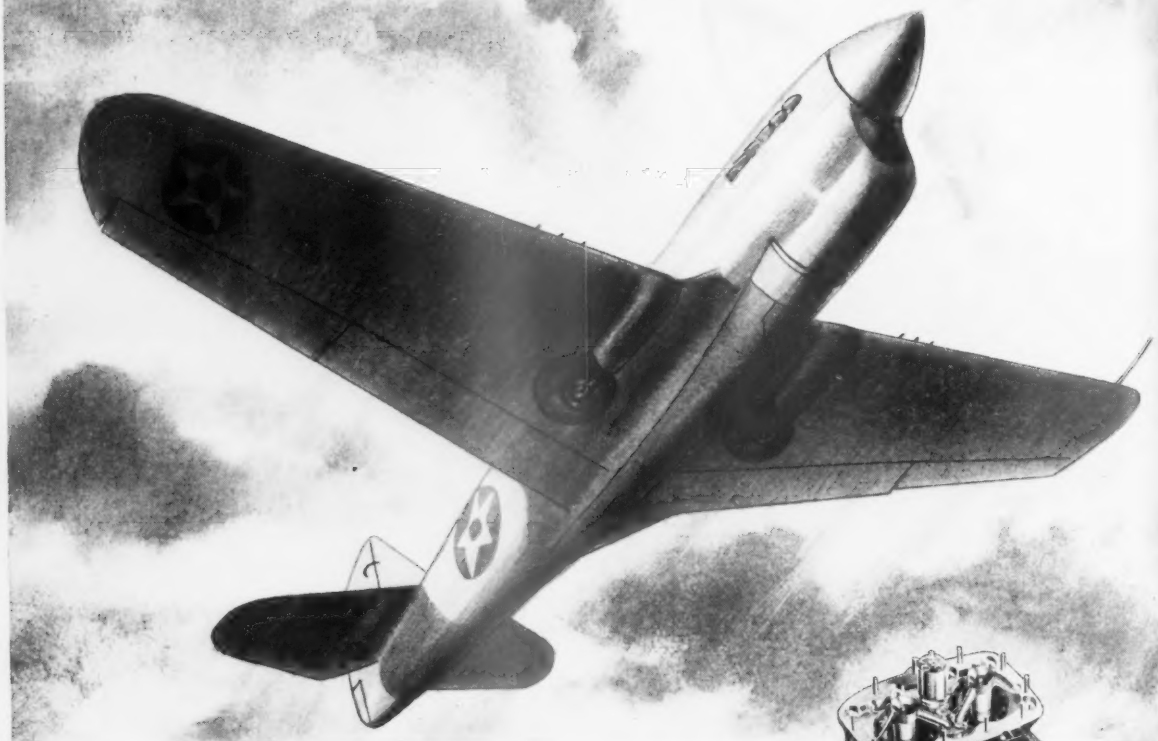
Second Annual Report of the Civil Aeronautics Authority, 1940; Superintendent of Documents, Washington, D.C., November 15, 1940; 60 pages, $0.25.

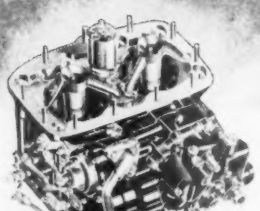
Annual report for the fiscal year ended June 30, 1940, covers the activities of the Civil Aeronautics Authority and of the Administrator of Civil Aeronautics before the reorganization that separated the functions of these two authorities.

Annual Report of the Civil Aeronautics Board, 1941; Superintendent of Documents, Washington, D.C., November 15, 1941; 62 pages, $0.35.

The first annual report of the Civil Aeronautics Board for the fiscal year ended June 30, 1941. This report does not cover the activities of the Administrator of Civil Aeronautics for the fiscal year 1941.

When Ground-Strafers Rush "Upstairs"





"STROMBERG" CARBURETION
PROVIDES CONSTANT POWER FLOW

Low altitude attacks on enemy supply columns by American fighter and bomber planes call for unfailing power in the "get-away." Here the automatic fuel metering, assured by "Stromberg" Injection Carburetors, instantly provides the increased power needed for lightning-fast, vertical climbing.

The amazing *flexibility* of "STROMBERG" Carburetion, by compensating for all changes in altitude, speed, propeller pitch or throttle position, assures complete maneuverability. Even gravity and inertia effects become negligible.

On all types of planes, "STROMBERG" Injection Carburetors not only provide constant power flow, but also maximum freedom from ice formation (due to vaporization of fuel) and maximum economy of operation.

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Precision Equipment by Bendix
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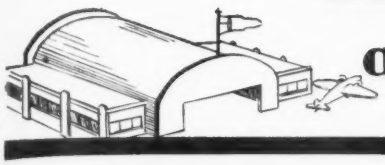
BENDIX PRODUCTS DIVISION
of Bendix Aviation Corporation
South Bend, Indiana

House Organs and Catalogues



Tube Spinning Process

A new spinning process for shaping and closing the ends of tubing is described in a 28-page booklet. It is explained that the process requires no special machines except the tool used for the shaping process. The only required elements are a means of holding and fitting the tube and a means of holding and rotating the tool, which consists of a recessed die of the desired shape. Parts now being manufactured by this process are illustrated. These parts range from $^{7}/_{16}$ to 3 in. in diameter. It is stated that the tubing material may be brass, copper, Monel metal, steel, aluminum, or magnesium. Closures in copper alloys and aluminum can be made in the spinning process without welding, brazing, or soldering. Heat generated by friction raises the temperature of the metal rapidly during the operation, in some instances to 800° or 1,400°F. The opening in the tube can be reduced to microscopic size and will seal against air pressure. There is no limit to the maximum wall thickness; limits are only on thinness. It is claimed that it is possible to form a closure on a 2-in. tube with 0.016-in. walls. Another advantage of the process is the ability to thicken or upset the end of a tube. *Wolverine Tube Division, Calumet and Hecla Consolidated Copper Company.*

The Spectrograph

Watchdogs of Production. The first of two articles on the importance of the laboratory technician's role in aircraft production is concerned with the spectrographic laboratory. It describes the action, construction, and operation of the spectrograph machine. By an ingenious application of electronics to a photographic record, this machine is able to determine variations in the element content of metals. It is stated that the spectrograph not only effects a great saving of time but is also able to detect materials that might escape chemical analysis. *The Pegasus*, June, 1943.

Adhesives and Finishes

A folder containing 20 sheets describing the many types of Bostik adhesives and finishes and their uses has been issued. Instructions for the application of these adhesives are given and tables show the results of adhesive tests. One sheet contains information on Bostik 299 cement for the waterproofing of seams in the wings, stabilizers and cabins of airplanes. Other cements and finishes for aircraft also are discussed. *B. B. Chemical Company*, Cambridge, Mass.

Gun Mount Development

Fire Power Plus. John Trotter. Less than five years ago engineers of the Bell Aircraft Corporation introduced an improved design of 0.50-caliber gun mount. The writer describes the development of this gun adapter and tells of its advantages. Instead of the simple coil springs that were used at that time on gun mounts, Bell substituted a hydraulic shock absorber to be employed in conjunction with a light spring. The hydraulic device dissipated the recoil energy and for the counter recoil stroke, and a spring was adopted with just sufficient strength to return the gun. Early experiments on this innovation were confined to a standard type automobile shock absorber. But after acquiring basic information, the absorber was then calibrated on a dynamic testing machine, and the resulting data inspired a small, light shock unit that has remained basically the same up to the present time. *The Bellringer*, June, 1943.

Intraplant Movement

Keep It Moving. A series of brief descriptions on several items in Consolidated Vultee's network of delivery and communication systems. Among the equipment noted are: a scale for counting nuts and bolts before they are routed; a tractor-like carloader for transporting and stacking boxes; a small electrically powered truck for the delivery of materials and parts; and a continuously moving trackless trolly for conveying personnel from one part of the plant to another. *Plane Talk*, June, 1943.

Properties of Plywood

Plywood—How It Bonds, Bends and Breaks. The structural advantages of resin-bonded plywood are described. It is explained that moisture content more than any other single factor controls plywood quality and, hence, plywood's success or failure in critical applications. For this reason, aircraft plywood specifications define rigid limits of moisture content in veneers and plywood, which at first glance may appear to be unnecessarily strict but really are essential because moisture content controls bonding, breaking, and bending. A table is furnished indicating the preferable range of moisture content for a variety of veneer assemblies. *The Resinous Reporter*, May, 1943.

Protective Coatings

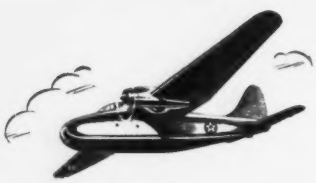
A 12-page data bulletin describes essential uses of Ucilon, a new surface coating material. It is explained that Ucilon is formulated from improved synthetic resins and that it produces tough, flexible coatings that are resistant to organic and inorganic acids, alkalies, salts, alcohol, gasoline, oils, greases and moisture; it also has excellent dielectric strength and can be readily applied to wood, metal, concrete and other surfaces by brushing, spraying, or dipping. Ucilon F, a special formulation for use where there is contact with food products, is also described. *United Chromium Incorporated, New York.*

Freight By Air

Flying Freight. Robert S. Ball. The prewar air transport record is reviewed and the future of air transport is discussed. It is believed that polar routes will not be practical, since global aviation is corollary to the domestic air transportation in that the greatest volume of business and the most profitable operation derives from the comparatively short-haul load. It is stated that after nearly 20 years of transcontinental air travel, none of the major lines has yet incorporated a nonstop coast-to-coast schedule, although there has been equipment that is capable of making such a flight, and a fair number of through passengers. It is more economical (hence profitable) to break the flight two or three times. A high-speed, nonstop service is predicted just as soon as the traffic and equipment justify it. *Service Engineering*, Spring, 1943.

The ultimate in safety for aircraft assembly:

WARM-SETTING *NON-ACID* PHENOL-RESIN GLUE



Such a glue (CASCOPHEN LT-67) is described in Technical Bulletin 104, sent on request.

Skilled engineering advice is available.

Address—Casein Company of America, (Dept. AR-7), 350 Madison Avenue, New York 17, N. Y.

CASEIN COMPANY OF AMERICA

Aircraft Glues

DIVISION OF THE BORDEN COMPANY

Phenol-resin, Urea-resin and Casein glues to meet all aircraft specifications

Spring Design

Spring Design and Engineering. Springs and their design are discussed in a manual issued for executives, engineers, production men, and purchasing agents. The manual contains formulas of spring design and engineering for compression, extension, torsion, flat spiral springs, flat springs, and wire forms, with illustrations, diagrams, and tables. Detachable extension sheets following the diagrams provide space for making notes and sketches. *Mid-West Spring Manufacturing Company*, Chicago, Ill.

Cost System

Watch the Cost—It's Money in Your Pocket. The Airesearch Manufacturing Company's factory cost system is depicted by a series of illustrations, set up in round-the-clock fashion. Starting with the customer's order, the statement of 26 operations follows through the complete list of transactions and departments until payment is received from the customer for delivery of the units. *The AiResearcher*, May, 1943.

Master Layout

They Loft When They Sit Down to Draw. Roland Bradley. The function and procedures of Boeing's master layout unit are noted. The materials used and the progression of work for producing the full-sized steel drawings from which templates are made are discussed. Part of the article is devoted to a description of the grid machine, which has eliminated the necessity of scribing reference lines by hand. *Boeing News*, May, 1943.

Wooden Airplanes for Decoys

Chinese Decoys . . . Fool Jap Shark Hunters. Roosevelt Der Tatevasion. This is an eyewitness story of how Chinese engineers at an air base in the Far East built wooden reproductions of the Curtiss P-40 for use as decoys. The success of the idea was revealed when Japanese Zero fighters came down and strafed the dummies. *Curtiss Fly Leaf*, March-April, 1943.

Radio and Electronics Handbook

A condensed handbook of formulas, charts, and data most commonly used in the field of radio and electronics is offered at a nominal price. The subjects are conveniently arranged and cross indexed for ready reference.

The book is divided into four parts covering mathematical data, radio and electronic formulas, engineering and servicing information, and a set of four-place tables of logarithms and trigonometric functions.

Formulas are given for decibels, resistance, capacitance, inductance, re-

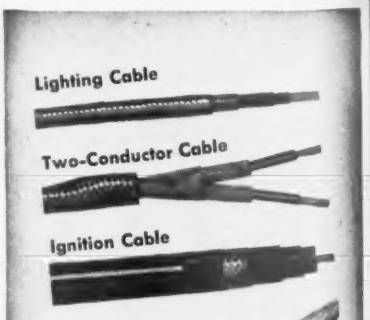
IT'S WIRY JOE FOR AVIATION WIRE and CABLE

There *was* a time that Wiry Joe was merely the largest independent manufacturer of replacement wiring for the automotive industry.

Now, Wiry Joe is also known as an important source of supply for every type of electrical wire and cable for aircraft. The complete line includes starter cable, high-tension cable, primary cable, both original and replacement. Wiry Joe also makes power and welding cable.

And just as Wiry Joe automotive cable won a name for quality, so, too, has Wiry Joe aviation cable. Every item in the line is built to meet rigid Army and Navy specifications, and is produced under the Dostam method of manufacture for uniformity, dependability, high efficiency and long life.

Inquiries regarding wire and cable for any type of service will be answered promptly.



Wiry Joe

AVIATION CABLE

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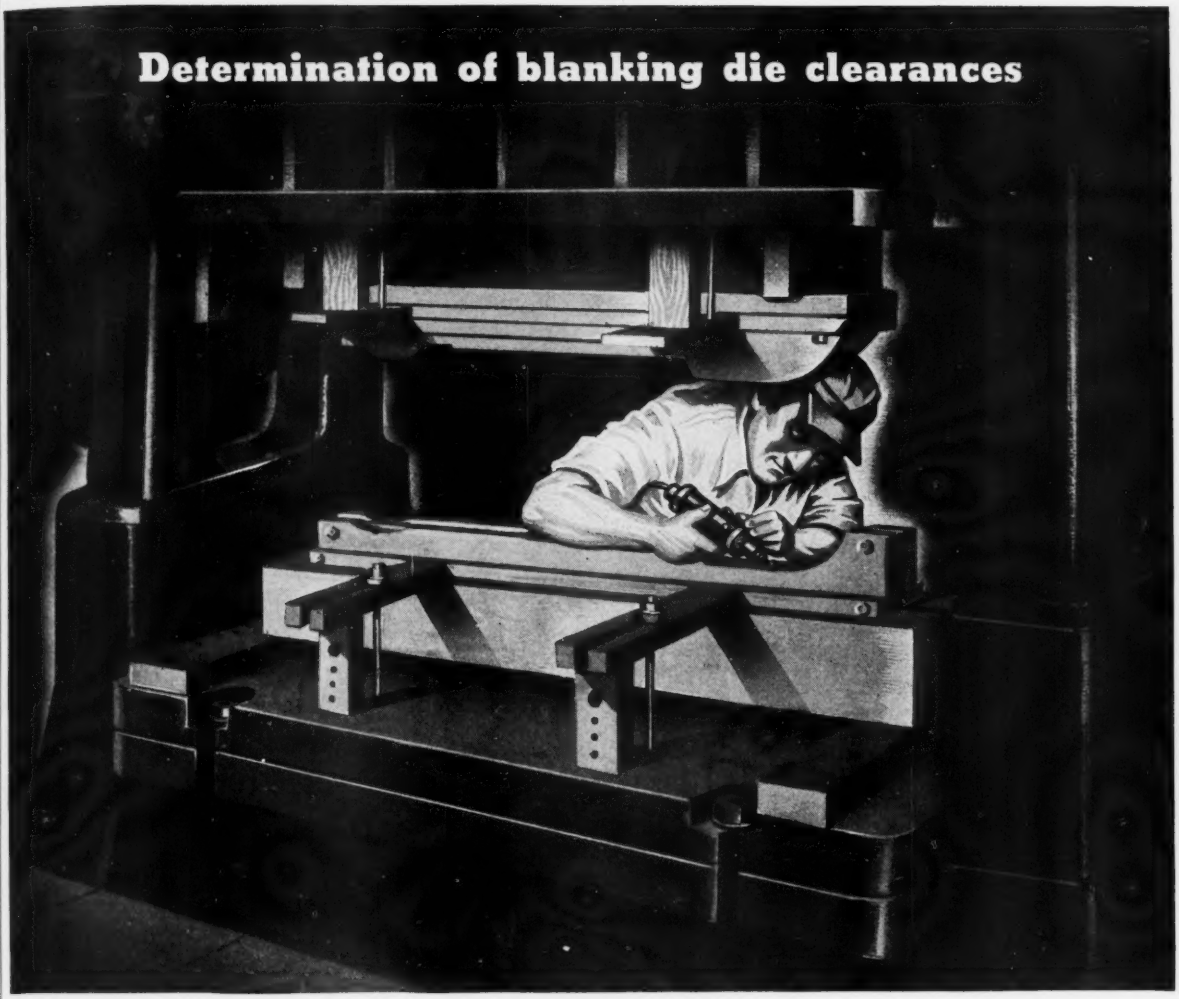
Determination of blanking die clearances



Information supplied by an Industrial Publication

Determination of proper blanking die clearance depends on several factors; thickness and physical properties of stock, relation of punch diameter to stock thickness, specified part tolerances and press power and size.

Recommendations of material suppliers regarding clearances for every type of blanking operation can usually be followed. Lacking recommendations, or when clearance must be determined by experiment certain simple rules give reasonably accurate results.

The amount of clearance varies from 5 to 12% in direct proportion to the stock thickness. Closer tolerances call for smaller clearances. The following table gives general average total clearances.

	Close Tolerance	General Run
Brass and Soft Steel	5%	8%
Medium Rolled Steel	6%	10%
Hard Rolled Steel	5-7%	12%

When the blanking or piercing hole must be held to a close tolerance, clearance is added to the punch dimensions. When the blanked part must be held to close tolerance, clearance is subtracted from the dimensions.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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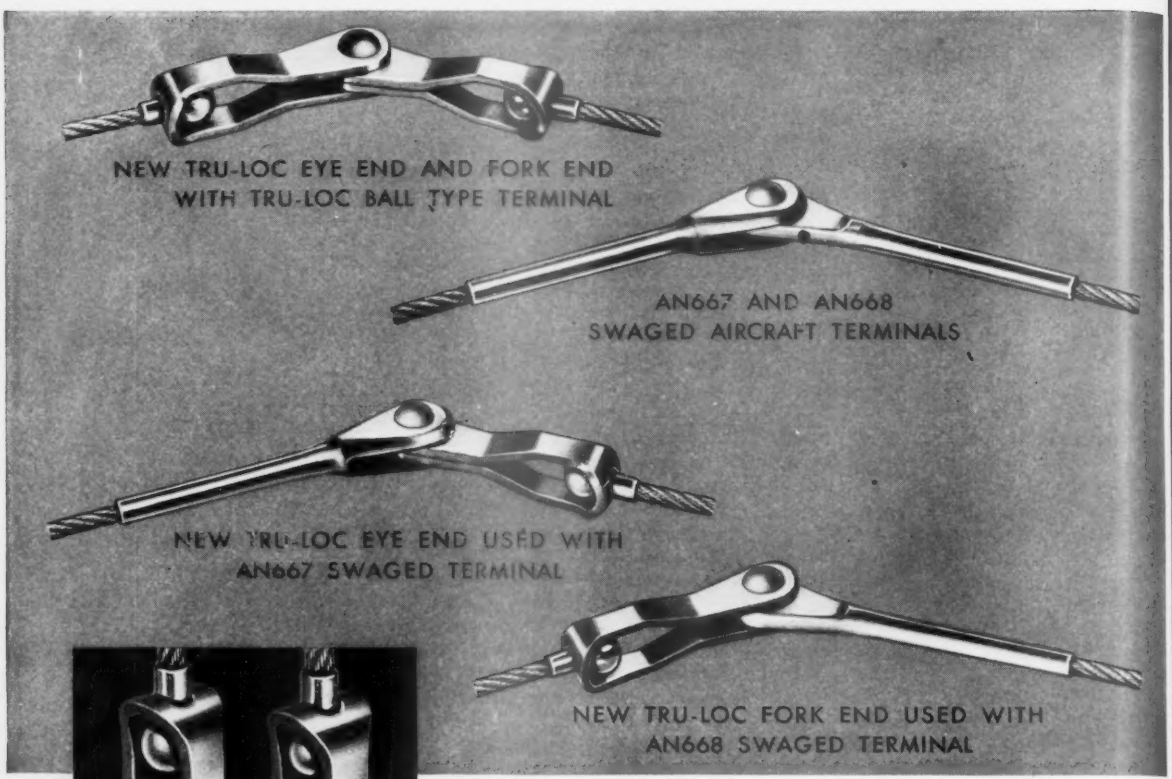
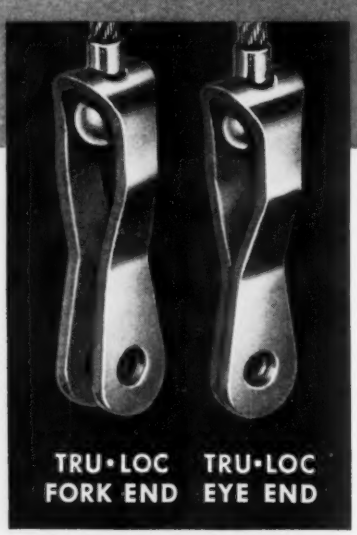

NEW TRU-LOC EYE END AND FORK END
WITH TRU-LOC BALL TYPE TERMINAL
AN667 AND AN668
SWAGED AIRCRAFT TERMINALS
NEW TRU-LOC EYE END USED WITH
AN667 SWAGED TERMINAL
NEW TRU-LOC FORK END USED WITH
AN668 SWAGED TERMINAL



DON'T LET SLOW DELIVERIES OF AN667 AND AN668 FITTINGS STOP YOU—THESE NEW TRU-LOC EYE END AND FORK END FITTINGS ARE PRECISELY INTERCHANGEABLE WITH THEM AND READILY AVAILABLE

GET A COPY OF THIS NEW FOLDER. This data folder gives you the complete story of TRU-LOC Eye End and Fork End Fittings—exact dimensions and all other essential data. It shows you definitely how to end at once any delays caused by the necessary slower deliveries of AN667 and AN668 Fittings. . . . To obtain a copy, write our Detroit office on your company's letterhead.

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ESSENTIAL PRODUCTS . . . TRU-LAY Aircraft, Automotive, and Industrial Controls, TRU-LOC Aircraft Terminals, AMERICAN CABLE Wire Rope, TRU-STOP Brakes, AMERICAN Chain, WEED Tire Chains, ACCO Malleable Castings, CAMPBELL Cutting Machines, FORD Hoists, Trolleys, HAZARD Wire Rope, Yacht Rigging, MANLEY Auto Service Equipment, OWEN Springs, PAGE Fence, Shaped Wire, Welding Wire, READING-PRATT & CADY Valves, READING Electric Steel Castings, WRIGHT Hoists, Cranes, Presses . . . *In Business for Your Safety*

actance, resonance, frequency, "Q" factor, impedance, conductance, susceptance, admittance, transients, peak average and R.M.S. voltage and current values, meter shunts and multipliers, vacuum tube constants, etc.

The data section covers such subjects as radio color codes, interchangeable tubes, pilot lamps, plug-in ballast resistors, and coil winding. *Allied Radio Corporation, Chicago, Ill.*

Magnesium Production

The Fisher Magnesium Scrap Book has been issued for the purpose of providing information on the production of magnesium. Essential facts on the subject are given for those who are not familiar with recent methods. Sections of the book cover finishes, fuels, melting, fluxing, inhibitors, fire prevention, and crucible pots. *Fisher Furnace Company*, Chicago, Ill.

Government-Approved Finishes

A loose-leaf catalogue of U.S. Government specified and approved finishes has been furnished by the manufacturer of Alaka lacquers. The catalogue is titled *Facts About United States Government Specification Finishes* and contains 19 pages of information on the subject. *Lacquer & Chemical Corporation*, Brooklyn, N.Y.

Martin Wings Built by Fairchild

Metal Wings for the PBMs. A series of notes on how Fairchild Aircraft fabricates metal wings for the Martin PBM-3 and 187. Comments on production and inspection procedures, personnel, transportation of the wings, and plant facilities are included. *The Pegasus*, June, 1943.

Electronics in Industry

Electronics . . . Giant Genii of Aviation. Edward R. Grace. The important part that electronics is playing in industry is discussed. It is stated that the War has swept the subject of electronics into the foreground of military and industrial thinking. Today, electronic tubes and circuits are being applied so rapidly to new and important uses in so many fields that it is almost impossible to keep pace with developments. The swift, steady climb of monthly production figures of military aircraft is but an indication of the force of electronics as applied not only in the production of aircraft engines, fuselages and wings, propellers, and control devices but in the operation of aircraft in combat. In communication and production, the electronic tube is expanding the potency of aircraft.

It is shown that without the electronic control devices and circuits, months of time and millions of dollars would be lost under the pressure of war production, which demands accuracy, balanced weight, lack of vibration, resistance to torsional strain, and unfailing performance of reciprocating parts. The penetrating eye of microanalysis, through x-ray photography, detects fractures and abrasions in metal parts. Flaws hidden to the naked eye are revealed through the power of electronics. The stroboscope, an invention of Westinghouse, permits the study of propeller blades while rotating at 1,800 r.p.m. Design engineers use electronics in engine tests to plot increasing detonation pressure curves. Each part of an engine, from spark plug to supercharger, can be pretested before complete assembly of the engine through the application of electronics. *Service Engineering*, Spring, 1943.

Lightweight Combat Hangar

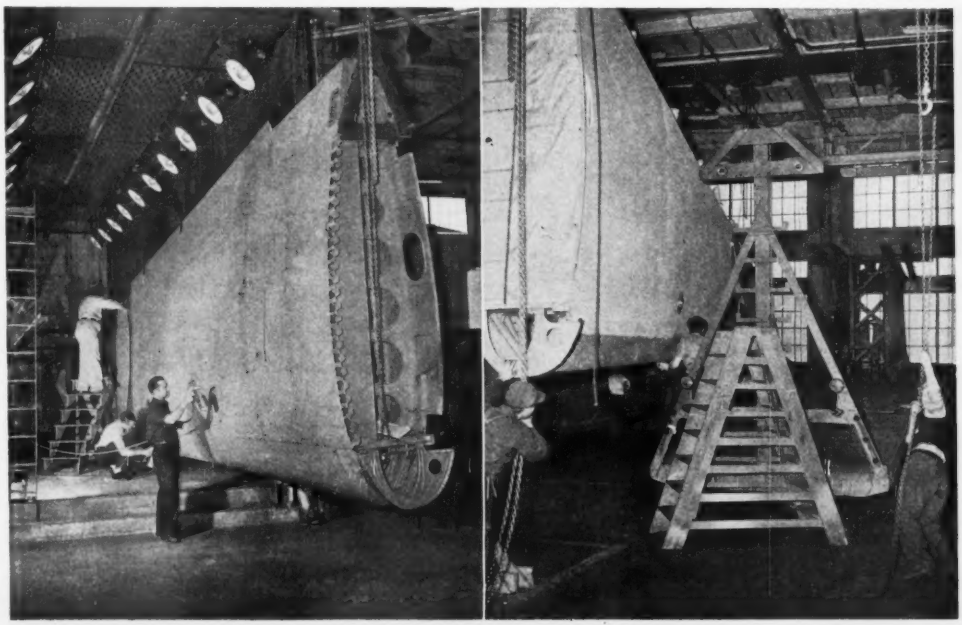
Butler lightweight combat-type hangars for aircraft are described in a 6-page folder. It is explained that the War has created a need for a sizable building for housing aircraft which can be transported by air in knockdown form and erected in a few hours. United States engineers with the Army Air Forces developed a structure to fulfill these requirements, and the Butler Manufacturing Company was chosen to further develop and fabricate the structure.

The final development is stated to be a hangar that is readily camouflaged, most resilient to explosion force, and easy to repair. The canvas envelope can be camouflage-painted and the steel frame affords anchorage for contour camouflaging. The depth between the top of the steel ribs and the canvas offers opportunity for deceiving light-and-shadow camouflaging effects.

The envelope is composed of reinforced canvas strips corresponding to the width of the 16-ft. steel bays and the length of the arch to be spanned. These are widely lapped and tightly rope-laced together. The entire envelope is raised and suspended on a system of ropes and pulleys attached to the steel supporting structure. The inherent, billowy resiliency of the canvas envelope is intended to absorb much of the force of explosion. *Butler Manufacturing Company*, Kansas City, Mo.

Norden Bombsight

Bombs Away. Lt. Henry D. Chism. This article includes some data on the



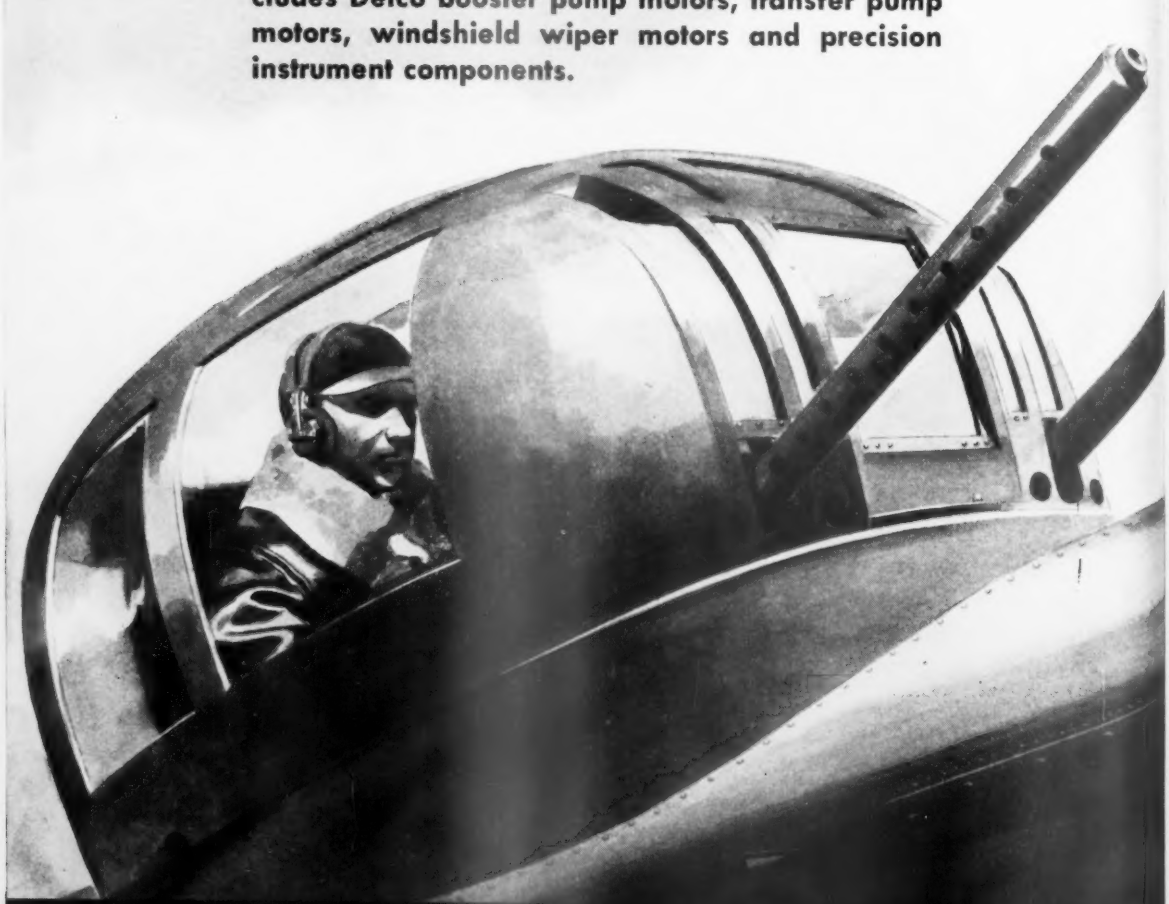
Courtesy of Fairchild Engine and Airplane Corporation

Martin bomber wings have fittings installed (*left*) and are loadedfor shipment (*right*).

Ball of Fire

Scourge of attacking aircraft, the power turret has proved a deadly weapon in the defensive armament of America's bombers. Best testimony to its effectiveness is the healthy respect that Jap and Nazi airmen have developed for it—through hard experience.

Special Delco motors, conforming to latest military specifications, are now being built to meet the power requirements for bomber turrets. Other aircraft equipment supplied by Delco Products includes Delco booster pump motors, transfer pump motors, windshield wiper motors and precision instrument components.



DELCO MOTORS

DELCO PRODUCTS *DIVISION OF* **GENERAL MOTORS**

Norden bombsight. The writer, a U.S.A.A.F. bombardier, quotes from a description of the bombsight by John Mecklin of the United Press. The details refer mostly to how the bombsight operates. *Plane Talk*, June, 1943.

American Standards

A new list of American Standards has been published. It includes more than 600 American Standards of which 94 represent new and revised standards approved since the last (August, 1942) issue of the list.

A special section is devoted to American War Standards—standards developed specifically for war production needs. Because every Government order is based on specifications and because standards are constantly used in simplifying the production problem, conserving materials, pegging quality to price control, etc., trade associations are finding the standards to be of considerable value.

Other standards include definitions of technical terms, specifications for metals and other materials, methods of test for the finished product, dimensions, etc. They are intended to cover every important engineering field and serve as a basis for many municipal state, and Federal regulations.

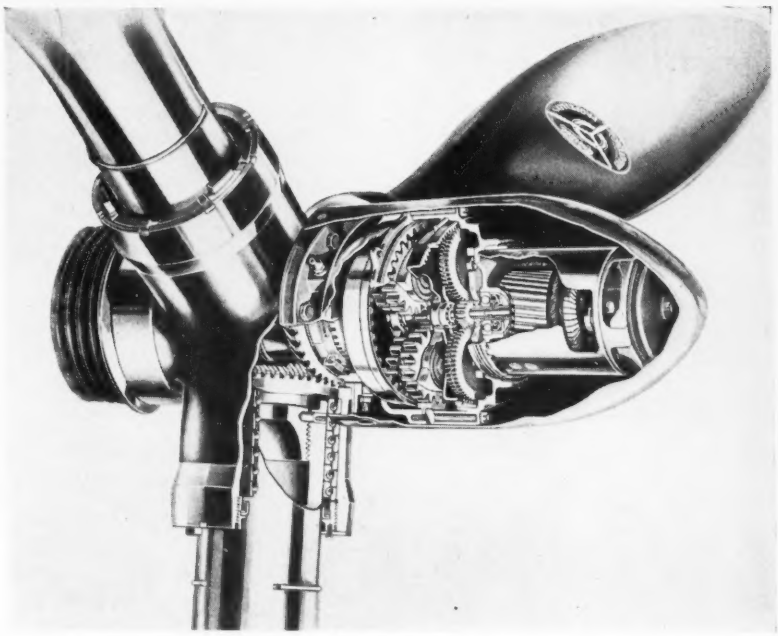
In each case, the standards approved by the A.S.A. represent general agreement on the part of maker, seller, and user groups as to the best current industrial practice. *American Standards Association.*

Conversion Chart of Pipe Fittings

To simplify the problem of finding Army-Navy standard tube and pipe fittings for use as replacements for the now inactive Air Corps and Naval aircraft factory fittings, The Weatherhead Company has issued a two-color, 32-page set of indexed conversion charts illustrating AN, NAF, and AC standard tube and pipe fittings. Specifications, numbers, and other data for each part are given along with corresponding data for Weatherhead and Parker Part fittings, making possible quick comparisons between them. This facilitates rapid determination of manufacturers' numbers that are used to identify similar parts. It also facilitates the finding of currently active fittings that could be used to replace the old NAF and AC parts. Text and illustrations are devoted entirely to showing the fittings and data, the charts being nonpromotional in nature. *The Weatherhead Company*, Cleveland, O.

Shaft Joints and Assemblies

A catalogue on Beco shaft joints and assemblies of both the hinged and universal type contains descriptions of the company's consolidated hinged joint with an effective operating range from 0° to 92° in any one geometric plane and the Brooks universal joint with effective operating range at angles from 0° to 360° in any geometric plane. Accompanying the descriptions are data sheets on blueprints of the joints themselves and the brackets, expansion couplings, assemblies, shaft hangers, and accessories used for their installation. The catalogue also contains information on Beco shaft couplings, hangers and assemblies, universal joint covers, shaft expansion couplings, operating gears, engine controls, steering controls, valve controls, and ventilation controls. *Brooks Equipment Corporation*, New York.



A cutaway view of a Curtiss electric propeller manufactured by the Propeller Division of Curtiss-Wright Corporation. Shown is the mechanism that controls the blade pitch. An electric motor regulates the pitch of blades through planetary spur gears and bevel gears. (*See* "Bevel Gears in Aircraft. Part II." Page 163.)

Data on Steel

U.S.S. Air-Ten Steels. This report gives certain preliminary engineering data concerning the physical properties and spot-welding characteristics of thin low-carbon steel sheets that contain no strategic alloying elements. These steels supplement the stainless and alloy grades that are produced by the U.S. Steel Corporation. It is stated that little was known of the physical characteristics of plain carbon steels in the relatively higher strength ranges and in extremely thin sections. Results recorded show that yield strengths from 25,000 to 100,000 lbs. per sq.in. are obtainable with ductility and formability decreasing with increasing strength. Information is included on five grades, C-25, C-40, C-50, C-80, and C-100, these symbols indicating the presence of carbon and the yield strength.

The development has included improvements in the rolling of thin sheets to satisfy the need for the least possible thickness and weight variation and for surface free from defects that would be detrimental to service life. *Carnegie-Illinois Steel Corporation*, Pittsburgh, Pa.

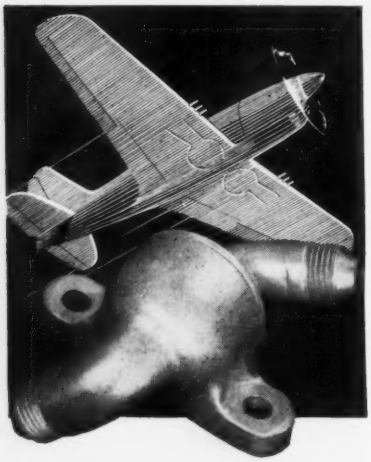
Training Film Circular

Complete information on two apprentice training films, titled *The Metal Working Lathe* and *Plain Turning*, is contained in a four-color circular, No. 8-A. The films are supplied on a free-loan basis to war plants and schools for training new lathe operators.

They are full-color, 16-mm. sound films and are based upon the book *How to Run a Lathe*. They show what a lathe is for, how it operates, the principal lathe operations, and the application of these operations on a representative job. It is stated that the use of these films in training new operators supplements instructional work, reduces personal supervision, and helps reduce errors through an effective presentation of the correct lathe practices. *South Bend Lathe Works*, South Bend, Ind.

Engine and Plane Performance

Problems involved in the design of military aircraft, with special reference to engines and superchargers, are set forth in language comprehensible to the layman in an 80-page book titled



Low Torque

CHIKSAN

Ball - Bearing Hydraulic Swivels for aircraft are designed to individual manufacturer's specifications for application on oil and fuel lines, brake lines and hydraulic lines . . . wherever movement is essential.

Light Weight

Made from aluminum alloys, steel or other materials suitable to the purpose for which they are to be used.

Low Torque

Ball bearings of proportionate size and capacity assure easy turning with minimum torque at high or low temperatures and pressures.

End Connections

Either AN or any other special end connections, as well as standard threaded ends, flanged ends or bored for welding.

WRITE FOR COMPLETE ENGINEERING DATA. ADDRESS DEPT. AV.

CHIKSAN TOOL COMPANY
BALL BEARING SWING JOINTS for ALL PURPOSES
BREA, CALIFORNIA

Airplane Power. The writers discuss problems that are common to all types of aircraft engines, regardless of whether they are liquid- or air-cooled. The relations between engine and plane performance are shown. The wide variety of aircraft equipment needed to meet the diversified requirements of the fighting forces is described.

The necessity for compromises is emphasized. Sections are included covering engines and altitudes, types of superchargers, service ceiling versus critical altitudes, and a summary. Interesting facts and technical definitions are given in an appendix. *General Motors Corporation.*

Additional N.A.S. Sheets

The National Aircraft Standards Committee has issued the following: revised editions of the Alphabetical Index and Numerical Index to National Aircraft Standards; a list of sources of supply for N.A.S. items, giving the complete names and addresses of suppliers; and file replacement copies of N.A.S. 222 through 227 covering screws with Brazier heads and Phillips recesses. *National Aircraft Standards Committee.*

Aircraft Equipment

New catalogue sections describing equipment for the aircraft industry have been issued. These sections cover the model BT Brake Tester for equalizing and testing airplane brakes, the model E5 multipurpose assembly stand for radial and V-type engines, cargo-handling equipment, maintenance-handling equipment and propeller-handling equipment. Illustrations and specifications of the equipment are given. *Whiting Corporation,* Harvey, Ill.

Guide on Tool Steel Treating

Tool Steel Treaters' Guide. A guide covering tool steel and its treatment is offered as a source of information for shop men, shop and toolroom apprentices, warehouse men, and inspectors. The book tells how the steel is brought into the condition in which it is received in the toolroom and gives condensed data on the general methods of heat-treatment of the steel throughout the numerous stages involved in developing the finished tool or die. Several pages are devoted to definitions of some of the terms used in connection with steel. Reproductions of heat and temper colors at different temperatures are also included. *Bethlehem Steel Company.*

Handbook for Welding Operators

How to prolong the life of oxyacetylene equipment is contained in a pocket-sized booklet for welding and cutting

G&O Radiators
28th Year

ENGINE COOLING RADIATORS

•

OIL COOLERS

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The G&O Manufacturing Co.
NEW HAVEN, CONNECTICUT

The SpeedWay organization is tuned to war tempo, is tooled to war quantities and ready to "deliver the goods" where war demands that extra performance.

Among SpeedWay products are SpeedWay motors (from 1/3000 to 1/3 h.p., A.C., D.C., Universal, Direct-drive or Back Geared). With over 30 years of specialization in design and manufacture of electric motors and motor driven devices SpeedWay can provide standard or special motors to meet your requirements and Army or Navy specifications.

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operators. It lists do's and don't's for the man who uses the blowpipe and gives suggestions on the care and maintenance of blowpipes, regulators, and welding and cutting accessories. *The International Acetylene Association*, New York.

Bag-Molding Process

An article titled "Flexible Bag Molding of Curved Plywood" is contained in Bulletin No. 4 for May, 1943. The more important aspects of flexible bag-molding and fluid-pressure applications are outlined. Discussing the limitations of standard hot presses, the writer explains that this type of press exerts effective pressure in only one direction so that curved surfaces receive only part of the pressure. With the flexible bag method of molding, all pressure is fluid and there is omnidirectional pressure.

The writer discusses adhesives for use with the process, including Amberlite PR-14, and describes the method of applying flexible pressure to molded plywood. Tables and charts augment the description. *The Resinous Products & Chemical Company*, Philadelphia, Pa.

Maintenance Training

The Three R's of General Motors War Products Training Program contains a description and illustrations of the war-training activities of the organization. Emphasis is placed on the importance of repair, replacement, and reliability. It is explained that the staff of the General Motors Institute at Flint, Mich., assisted in designing and developing training courses for making many war products and cooperated with the Army and Navy in mapping out training programs for many camps. The course for soldier-students at the propeller mechanics school of the Aeroproducts Division at Dayton, which covers all phases of propeller service, is described, as well as the training program at the Allison engine maintenance, repair and service school. Other sections of the book cover training for the maintenance of gun directors, electrical equipment, marine conversion, Diesel engines, transmissions, and guns. *General Motors Corporation.*

Launching an Airship

"Up Ship!" The launching of a new Goodyear-built Navy patrol ship at Wingfoot Lake, Akron, O., is described. It is noted that the launching is carried out without fanfare and that there is no special ground crew, since the men who assemble the aircraft act in that capacity.

The airship moves out on the field behind the mooring mast with a ring in its nose and, when the signal to go is received, the ground crew cuts loose the lines, the ship points its nose skyward, and another delivery to the Navy has begun. Tests carried out on the airship before delivery are described. They include trial flights, a shakedown cruise; climbing, diving, and turning trials; speed and fuel consumption tests; and examination by Goodyear and Navy inspectors. *Alert!* May, 1943.

Survey of Aviation Industry

The Aviation Industry is the title of a 44-page book presenting a survey of the aeronautical industry. The development of aviation from before the first World War to the present is traced. A chart shows airplane production in the United States from 1920 to 1940, and a table contains figures on the manufacture and export of planes during that period. Air-mail service is discussed in another section. Figures on the financial record of air-mail Government operation are given.

The development of commercial air transport is described with the aid of charts showing the growth of air lines in the United States from 1924 to 1941 and the passengers carried on scheduled flights during the same period. Other sections of the book cover air freight and express operations, the private plane, the influence of the present World War on aviation, and aviation in the postwar period. *The Curtis Publishing Company*, Philadelphia, Pa.

Aircraft Tires

A loose-leaf booklet contains technical data and engineering information on U.S. Royal airplane tires. The material in the catalogue includes descriptions of airplane tire dimensions, tire and rim measurements, tire and tube weights, nonskid contact area figures, and maximum worn section dimensions. Other sections are devoted to airplane tubes and tire valves, both rubber and metal. Through the use of charts, load deflection curves for smooth contour, high-pressure, low-pressure, and profile nose-wheel tires are shown.

It is stated that all data are subject to change and that all specifications may be modified by instructions from the Army, Navy, or the War Production Board. Revisions and additions will be issued from time to time. *United States Rubber Company*, New York.

Bendix Precision Instrument Produced by Delco Appliance

X-ray Eyes for Pilots. Some descriptive details are presented on the Pioneer Autosyn and its manufacture, under a subcontract, by Delco Appliance Division of General Motors. The function of this lightweight motor in multiple installations is to reveal to the pilot the exact movement and location of the moving parts of his plane and also to register such important data as engine speed and oil pressure. *Steel Horizons*, Vol. 5, No. 2.

Commercial Aircraft Development

Jenny to Caravan. Franklin D. Walker. The history of the development of Curtiss commercial aircraft is reviewed. Discussing the development of the Commando, which is designated as the C-46, the writer notes that the story goes back to 1918, the year the Post Office Department established the first important airway (Washington to New York) and pressed six converted Curtiss JN trainers into service to equip it as a mail route. Other Curtiss planes mentioned in this historic outline include the R-4-LM; the NC-1, which established a new passenger carrying route; the HA; the Eagle, first American tri-engine plane; the M-F pusher-type flying boat, originally designed for the Navy, but later used in mail service in Alaska; the Carrier Pigeon; the Seagull; and the Condor. *Curtiss Fly Leaf*, March-April, 1943.

Costs and Profits

Fixed Fee Explained by Donald Douglas. Because many people have the erroneous idea that under the war-time contract system a manufacturer's profits increase as his costs increase, an article explaining the fixed fee is presented. Mr. Douglas explains that the cost-plus-fixed-fee contracts under which most of the work is being performed are in reality "fixed-fee" contracts and that the fixed fees that are received do not vary with the actual costs incurred.

The fixed fee on each contract is based wholly on the originally approved estimated cost of completing the work and, should the cost actually incurred exceed the estimate on which the fee is based, no additional fee is received. In effect, allowable costs in excess of the original estimate are reimbursed to the contractor without any fee. This represents a marked contrast to the "cost-plus" contracts of the previous war, where fees were received on costs in excess of original estimates. *Douglas El Segundo Airview News*, May 25, 1943.

Catalogue of Technical Books

Technical Library. A catalogue of books and other publications contained in the technical library of Rotol Airscrews Ltd. has been published. In-

cluded in this catalogue are a classified list of books, reprints, and trade catalogues, with index, and also lists of reports, translations, specifications and instructions, periodicals received for circulation, and bound volumes of periodicals. *Rotol Airscrews Ltd.*, Gloucester, England.

Bulletins on Furnaces and Heaters

A 16-page two-color bulletin contains illustrations of different types of forging furnaces, together with data on sizes, burnering, and other information. A bulletin has also been published on the company's gas- or oil-fired rivet heaters and contains data on sizes, burnering, and fuel consumption. *Mahr Manufacturing Company, Division of Diamond Iron Works, Inc.*, Minneapolis, Minn.

Aerial Torpedo Production

Tin Fish from the Sky. An article describing how the Pontiac Division of General Motors is building aircraft torpedoes. It is explained that the production of torpedoes weighing nearly a ton each requires a skill and manufacturing technique comparable to that required for making fine watches. Parts are manufactured for the gyros that control the torpedo. Some of these parts are so small that they must be lubricated with a medical hypodermic needle in air-conditioned, dust-free rooms.

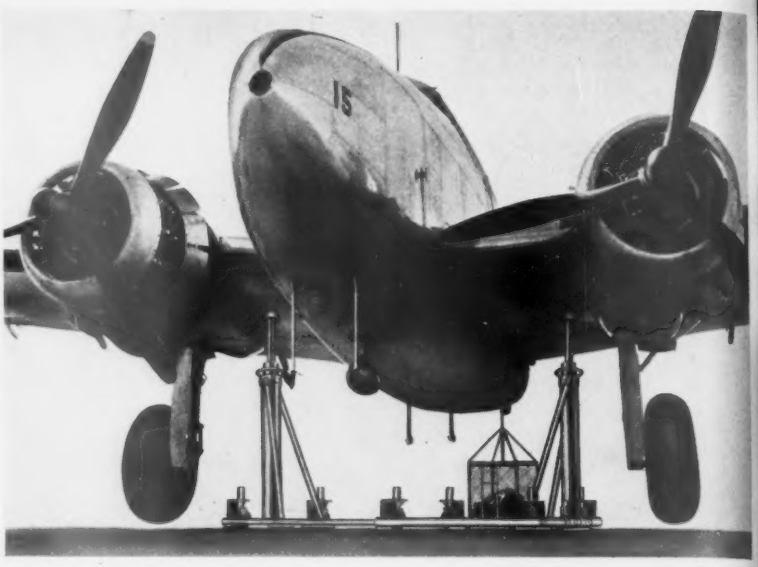
The development of the aerial torpedo is traced. It is stated that between the beginning and end of World War I torpedoes increased in diameter from 14 to 18 in. Then 21-in. torpedoes were developed, which is the size usually used today. The length of aerial torpedoes has increased from 10 to 24 ft. Torpedo production operations are pictured and diagrams illustrate two methods of torpedo-plane attack. *GM Folks*, June, 1943.

The PT-23 Group

Cooperation Does the Trick. This article contains some data on the pooling plan whereby five aircraft manufacturers build primary trainers based on the Fairchild PT-19 design. In addition to the PT-19, the trainers are known as the PT-23 and the PT-26 and are produced by Fairchild Aircraft Corporation, Aeronca Aircraft Corporation, Howard Aircraft Corporation, St. Louis Aircraft Corporation, and Fleet Aircraft, Ltd.

It is said that, in addition to being supplied by Fairchild with a complete set of dies and special tools, samples of each unit of the aircraft as pilot models, and necessary drawings and specifications, each of the other companies was able to obtain assistance in the training of their personnel for the manufacture of the training planes. Members of the PT-23 Group (as the coalition is called) order their own materials and accessories. However, matters of general concern are directed by a PT-23 Committee, on which are representatives from each of the participating companies.

Three subcommittees deal with special problems: one with procurement and the exchange of equipment; another with the Coordination of tools and gauges; and the third with the coordination of engineering information. *The Pegasus*, June, 1943.



Hydraulic cradle developed by the Customer Service Department of the Lockheed and Vega Aircraft corporations. It is operated by hand pumps and is adjustable to fit practically all types of land-based planes, as well as some amphibious aircraft. It is collapsible for easy transport by air.

Hydraulic Cradle

New Hydraulic Cradle Is Short Cut to Better, Faster Service. A new hydraulic cradle has been developed by the Customer Service Division of the Lockheed and Vega Aircraft Corporations. It is designed to provide safety and more efficient service operations and is credited with the following advantages:

(1) The lifting unit consists of two hydraulic jacks operated by hand pumps; (2) having an adjustable cradle, it will fit practically all types of land-based planes and some types of amphibious aircraft; (3) it gives the flexibility of wing jacks with the stability and safety of trestling; (4) it is collapsible for easy transport by air.

The jacks may be used as separate units if necessary. The jackheads are ball-shaped to adapt the pad to the dihedral of the various wings and the position of the airplane. The telescoping feature of the cradle has a minimum expansion of 8 ft. and a maximum of 14 ft. The range of lift is from 34 to 72 in. on the 10-ton model and 58 to 128 in. on the 17-ton model. *Global Service Log*, May, 1943.

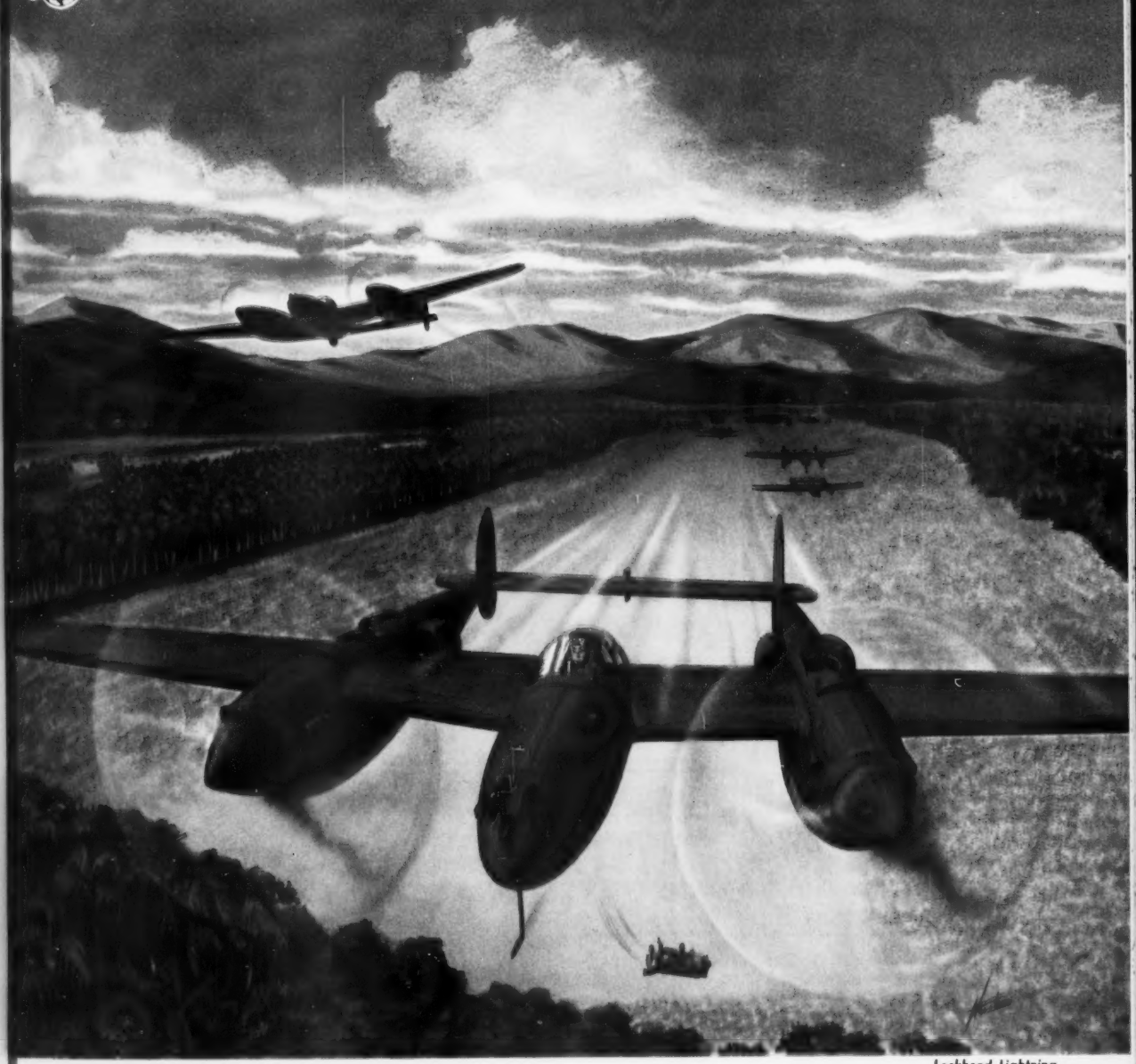
Increased Efficiency from Propeller Machine Tools

Short Cuts to More Props. Three examples are given to illustrate the methods by which the Hamilton Standard Propeller Division obtains the ultimate efficiency from its machine tools and adapts operations to the type of equipment available. One example describes the substitution of a Morton keyseater for a Pratt & Whitney vertical shaper with a rotary table. Through the use of special fixtures, the keyseater was converted into an automatic machine with a resultant laborsaving of 80 per cent and a 40 per cent increase in production.

The second example tells how a two-thirds saving of time was effected by a special eccentric polishing head for spider armbores. The eccentricity of this polishing head is derived from the utilization of cams. Incorporation of a work holder and a feed mechanism made the machine semiautomatic, and a special bob forms the radii at the bottom of the armbores.

The third example is concerned with an automatic machine that reduced the time and cost of making spring pack retainers. This machine uses a self-fed LaPointe broach. It is related also how careful job analysis resulted in the substitution of standard rectangular bar stock for the special type stock originally used for these small parts. *Steel Horizons*, Vol. 5, No. 2.

PERFORMANCE CONTROLS THE AIR



Lockheed Lightning

Lightning heads for a place to strike. Five miles up. Seconds are precious. Performance is vital. Every plane part must function faultlessly. Upon the skill and precision workmanship of millions here at home depend the success of a mission, the lives of our courageous sons. In this trust we *cannot* fail!

PESCO heavy-duty Fuel Pump for high powered planes.

ARMY E NAVY

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PERFORMANCE POINTS TO Pesco FIRST

DIVISION BORG-WARNER, CLEVELAND, OHIO

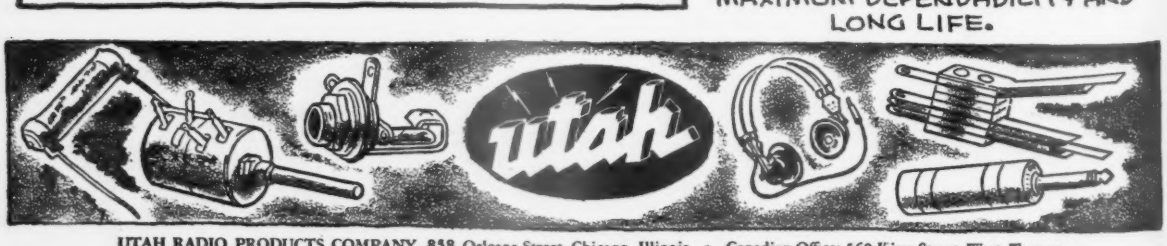
DO YOU KNOW THE **UTAH** PARTS USED IN THESE PRODUCTS? (ANSWERS AT BOTTOM OF PAGE)

① **AUTOMOTIVE TESTING DEVICES.** JEEPS ARE KEPT BOUNCING—TRUCKS ROLLING·· AND "TOMORROW" PLEASURE CARS WILL AGAIN BE KEPT SPINNING ALONG THE HIGHWAY. UTAH PARTS HELP THESE DEVICES OBTAIN THEIR UNCANNY ACCURACY.

② **ELECTRIC MUSIC INSTRUMENTS.** SOFT LIGHTS AND SWEET MUSIC—AND IT'S RELAXATION FOR SERVICEMEN IN THEIR OFF-DUTY HOURS. UTAH PARTS AMPLIFY THE TONES, AS THEY COME FORTH GOLDEN AND VIBRANT

③ **ELECTRIC THERAPY EQUIPMENT** LENDS ITS MAGIC HEALING POWERS TO SOLDIER AND CIVILIAN ALIKE. IN THIS APPARATUS WILL BE FOUND PARTS BY UTAH···ASSURING MAXIMUM DEPENDABILITY AND LONG LIFE.

THESE COMPRISE BUT A SMALL CROSS-SECTION OF THE VAST NUMBER OF PRODUCTS EMPLOYING UTAH PARTS. TODAY, UTAH DEPENDABILITY HAS ENLISTED FOR THE DURATION ··· AND UTAH PARTS ARE BEING MANUFACTURED FOR THE ARMY, NAVY AND MARINE CORPS. WHILE CONTRIBUTING 100% TO THE WAR EFFORT, UTAH IS KEEPING ITS EYES ALSO ON THE FUTURE. IN THE BRIGHT POSTWAR WORLD TO COME, THERE WILL BE GREATER ENJOYMENT AND CONVENIENCE IN AMERICAN HOMES···GREATER EFFICIENCY IN THE NATION'S FACTORIES··· BECAUSE OF THE WARTIME RESEARCH AND EXPERIENCE NOW GOING ON AT UTAH.



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From the Industry

Newly Developed Solenoid

A new line of positive action solenoids is announced. Designed to comply with electrical standards, Aeromac solenoids are claimed to provide the added advantage of a more powerful pull for their size than units of comparable construction.

These solenoids have a wide range of applications to aircraft mechanisms—for heat-control valves, bomb-release devices, and general valve control. Power input is extremely low for the high degree of actuating pressure exerted. Aeronautical Manufacturing Company, Niagara Falls, N.Y.

Franklin Engine Applications

A CG-4A troop-carrying glider made by Northwestern Aeronautical Corporation is the newest in a long line of experimental installations of Franklin aircraft engines. It is equipped with two 130-hp. Franklin air-cooled engines of the six-cylinder, horizontally opposed type. Franklin engines have previously been chosen for many experimental installations, including the Sikorsky helicopter, the Langley twin-engined plastic-plywood plane, and the experimental Northrop Flying Wing.

The manufacturer has also been assigned to develop completely new Franklin engines for both the Army Air Forces and the Bureau of Aeronautics of the U.S. Navy.

Among Franklin engines currently in quantity production for the Army Air Forces is a horizontally opposed, air-cooled, geared engine. This model was recently revealed to have satisfactorily completed an Army and Navy model test without reservation. Aircooled Motors Corporation, Syracuse, N. Y.

Washing of Small Bearings for Flight Instruments

Engineers of the Metal Washing Division of American Foundry Equipment Company, working with an important manufacturer of flight instruments, perfected a simple but efficient machine designed to clean and oil the bearings provided for such instruments without exposing them to room air or handling which would result in rusting from finger smudges. The bearing races to be handled in the unit vary in size from $\frac{1}{4}$ in. outside diameter up to and including $1\frac{1}{4}$ in. outside diameter. Since inside diameters are of varying sizes and types, the problem of adapting the machine to the different sizes of bearing races was introduced.

As finally designed, the bearing washer consists of a solvent container, a fractional-horsepower solvent pump, a solvent filter and the proper bearing adapters. If it is necessary on certain types of work to remove excess solvent from the cleaned bearings, an air-hose connection providing clean filtered air can be built into the cleaning unit. Overall dimensions of the unit are only 17 by 19 by 15 in., compact enough to be portable and yet designed for permanent location in a production line.

Operation of the unit is simple. The girl operator slips the bearing race to be cleaned over the adapter. Releasing a small plunger knob injects the bearing into the spray nozzle entrance. Solvent, under high pressure, is discharged from the nozzle and forced between the race and the balls of the bearing. By twirling the operating knob, all surfaces of the raceways can be exposed to the solvent. After the short cleaning period, the solution is turned off and the bearing is removed from the adapter. To eliminate manual handling after cleaning, a stripper mechanism is provided to remove the bearings from the adapter. The bearings fall into a small chute and are discharged into a container or cellophane bag.

This same bearing washing machine can also be used by manufacturers faced with the problem of removing dirt and abrasive particles from bearings used in motors, machines, and other mechanical devices. American Foundry Equipment Company, Mishawaka, Ind.

"Rubber" from Plastics

Successfully molded plastic grommets are reported to be in quantity production now in several different sizes. After finding that injection-molded resins closely resembled rubber in appearance, feeling and texture and after making tests that proved the plastic grommets to be a suitable substitute for rubber, the manufacturer put various sizes into production, with the aid of brief-cycle injection machines and multicavity molds. The tensile strength was determined as 1,000 lbs. per sq.in. with a satisfactory flexing quality from +180°F. down to −40°F. It is claimed that continued experiment and experience have resulted in costs being cut in half since plastic grommets were first made.

Further applications for rubber substitute plastic are being considered and initiated. These include bumpers, door jambs, odd-shaped gaskets, etc. Army mess stools, which formerly used rubber pads on the base of each leg, will use cups that have been injection molded. Bay Manufacturing Division of the Electric Auto-Lite Company.

Wood-Cutting Band Saw

An all-purpose contour and cutoff band saw for wood or plastic stock up to $8\frac{5}{8}$ in. thick is being offered in bench and floor models. The deep throat allows 27 in. diameter cutting.

When running at 1,200 r.p.m. the blade tension is claimed to be 20 to 40 per cent of other machines running at 600 r.p.m. An easy-to-read accurate blade tension scale is provided.

The framework is a one-piece steel structure. The wheel guard swings on a single hinge and must be closed before the machine can operate. The telescoping guard on the blade holds by friction when the lock handle is released and so it cannot drop.

The newly designed blade guides handle all blades from $\frac{1}{8}$ to $\frac{3}{4}$ in. and adjust by a single knob control. The 15- by $15\frac{1}{2}$-in. table is rigidly supported on heavy trunnions and will not sag under heavy cuts. It tilts 45° to the right and 10° to the left. The degree of tilt is indicated by an accurate scale. Boice-Crane Company, Toledo, O.

Skin Fastener

A handy skin fastener, specially designed for use by women workers, locks with fingertip pressure and greatly reduces time consumed in aligning holes and clamping skin assemblies, according to the manufacturer. No pliers or guns are needed with the new holder, which is designed for both flush and countersunk rivet applications.

Applied with either hand by pressing a large lever between thumb and fore-

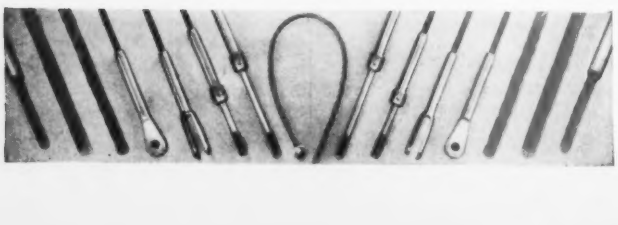
Time Saver . . . ROEBLING SLEEVE ELIMINATES SPLICING OF EYE ENDS, SAVES TIME AND CORD, DEVELOPS FULL STRENGTH!

THE SPLICING of eye ends, a tedious, time consuming task, can for many applications be eliminated by the use of this new Roebling development. A steel cylinder roughly three times the diameter of the cord on which it is to be used, the Roebling sleeve has two holes drilled side by side parallel to its axis. In making a "splice", the cord is passed through one hole and a thimble of proper size is put in place. The dead end of the cord is then pushed into the other hole, and any slack is carefully pulled through. With the thimble properly in place, the sleeve is then pressed or swaged with a suitable die—and the splice is done!

Not only does the new fitting save the time formerly required for tedious splicing operations, but it also saves appreciable quantities of the critical aircraft cord formerly required for splicing, eliminates need for skilled splicers, and permits rapid, easy fabrication of eye ends on cord. Complete assemblies using these fittings may be ordered from Roebling to your specifications.

This is not an isolated instance of a single development, but merely another in the long line of Roebling firsts in wire rope engineering. In Roebling's Development Laboratories, dozens of tests and projects are constantly in process, leading to developments to bring Victory faster. If you have a problem in connection with control cord, or any other wire rope product you may be using, bring it to Trenton. Roebling's skilled rope engineers will be glad to help you solve it!

Aircord Division
JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY
Branches and Warehouses in Principal Cities

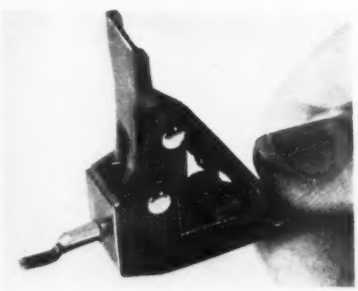


ROEBLING
AIRCRAFT WIRES . . . . TERMINALS
COMPLETE ASSEMBLIES

finger, it requires approximately 8 lbs. pressure to lock. The toggle trigger is arranged so that the fastener cannot loosen or fall off the job. Removal by means of pressure on a thumb trigger requires about 6 lbs. pressure.

The main part is a torsion spring made of hot-drawn oil-tempered wire. This spring exerts a direct pull of 35 lbs. at the point of contact with the skin. It is stated that tests with twice the possible load show no distortion of the spring or loss of pressure.

The manufacturer points out that, in addition to the time- and laborsaving features, the light pressure required, the smooth surfaces that make it easy on the hands, and the compact mechanism are all particularly adaptable for women and inexperienced workers. Stock sizes are 3/32 in. (drill—No. 40) in bright finish and 1/8 in. (drill—No. 30) in black finish. Clever Tool Company, Los Angeles, Calif.



A skin fastener specially designed for use by women workers for aligning holes and clamping skin assemblies.

Green Paint with Infrared Reflection Value

A new dark green camouflage is now being made by the du Pont Company. This camouflage finish reflects the infrared rays that, along with ultraviolet, represent the unseen three-fifths of sunlight. It shows up light instead of dark in aerial infrared photographs.

In contrast, ordinary green paints appear dark in aerial photographs, revealing details to the enemy. A military target blended into the landscape by the artful use of orthodox green paint would not escape detection by the infrared aerial camera, because the painted surfaces would stand out in marked contrast to the foliage, black against white in the photograph.

Now, however, the camoufleur may use green paints that not only visibly match surrounding natural greens but also equal their infrared reflectance powers and accordingly match in the infrared photograph as well. Other colors—olive and field drab, loam black, earth red, brown and yellow—are also possible in the range of paints that reflect infrared rays. E. I. du Pont de Nemours & Company.

Steelductor for Airplanes

One of the automotive industry's contributions to aircraft manufacturing has been the development of an ignition cable made from stainless steel. It is reported that the Electric Auto-Lite Company's seven-strand Steelductor high-tension cable has widely replaced the conventional 19-strand copper conductor.

Advantages of the seven-strand Steelductor in a shielded circuit for aircraft ignition are designated as its lower capacitance and higher voltage delivery. Tests indicate that a 4-ft. shielded length of steel conductor cable not only delivers 25 per cent more voltage but, during the starting of an engine and before ignition, provides a series of spark discharges offering improved starting performance. The maker states that at critical points such as extremely high and low speeds, the Steelductor produces a spark where conventional 19-strand copper cable fails to function. In addition to providing fuel economy through a delivered spark of longer duration, it is stated the lower capacitance steel cable reduces radio interference and prolongs spark-plug life. Electric Auto-Lite Company.

Radio-Noise Filter

New filters for the suppression of radio noise in aircraft applications, on circuits with generators, amplidynes, inverters, dynamotors, and other equipment, are particularly effective in the band of frequencies from 200 kilocycles to 20 megacycles. They are designed especially to attenuate radio-noise voltage to levels that will not interfere with radio reception. They are claimed to meet the requirements of U.S. Army Air Forces Specification No. 32331A, revised January 6, 1943.

These radio-noise filters are of the simple Pi type, where capacitances are connected between the ends of an inductance coil and ground return circuit. The capacitors of the filter act as a short circuit to the radio-noise voltage, and the inductance of the coil acts as a high-series impedance to the radio-noise voltage, thereby causing the major portion of the radio noise current to circulate between the input side of the filter and the source of the radio-noise voltage.

The filter reduces radio-noise voltage by a definite ratio (for a given frequency), rather than limiting the voltage to a fixed maximum value. Hence, for best performance, a filter should have a high attenuation characteristic throughout the complete range of frequencies for which filtering is desired.

When installing a radio-noise filter, it is essential to ground the base of the filter solidly and directly to the machine or conductor that is carrying the ground current.

The filter is symmetric and either line terminal can be connected to the noise source. It may be necessary to shield the lead between the machine, where the radio-noise voltage originates, and the input terminal of the radio-noise filter in order to avoid having the radio-noise voltage radiated into the area where it is desired to have a low noise level.

In some cases the application of a radio-noise filter may not in itself be sufficient to reduce the radio-noise voltage to the desired limit. It may then be desirable to add capacitors at certain points in the circuit, to shield the leads, or change their relative positions. If there is more than one source of radio-noise voltage, it may be necessary to use additional filters on each of these sources. General Electric Company.

Device to Improve Projection Welding

A device that makes the projection welding of steel studs on metal hinges and sheet metal surfaces practically foolproof has been perfected at General Electric's Schenectady Works.

The device calls for a vertically milled slot in the collet, which is located in the bottom electrode. The collet is tapered. When the stud is introduced in the collet and the upper electrode is depressed, the jaws of the collet close tightly about the stud. The resulting pressure causes the current to be distributed evenly on all sides and at the top of the stud near the welding zone rather than through the entire stud and then to the sheet.

Below the collet is a space for air, forced in under pressure by a hose. As soon as the welding is complete and the upper electrode is lifted, the air pressure forces the tapered collet upward. The collet expands and releases the stud. Binding of the stud on release was formerly a problem. When the collet reaches a height sufficient to release the stud, its movement is stopped by a setscrew that engages the bottom of the collet. General Electric Company.

Synthetic Rubber for Gaskets

Copper mesh coated with synthetic rubber has been adopted as a gasket material for internal combustion engines. The material has survived exhaustive tests and now is standard equipment for many airplane engines produced in this country.

The rubber-sheathed mesh, less than 15/1,000 in. in thickness, is being supplied by Goodyear for the Detroit Gasket and Manufacturing Company, which in turn supplies the complete gaskets for producers of aircraft engines. These gaskets replace the type that used asbestos, fiber, or similar materials. The copper-mesh gaskets are

claimed to be blowout-proof and are used to seal the crankcases of aircraft engines to prevent losses of oil by seepages, blowouts, or similar causes.

It is stated that 80-mesh copper screening is used for the gaskets. The fine wire has a tensile strength in excess of any internal pressure that may be encountered. The synthetic rubber coating provides the necessary binding medium for the wire mesh and also provides the resiliency required to obtain correct alignment in the assembly.

A gasket fabricated from this new material has the properties of high-tensile strength, flexibility, resiliency, oil resistance, dimensional stability, and accuracy. The Goodyear Tire & Rubber Company.

Aircraft Radio Relay

A general-purpose radio relay, the series 345 designed for use in aircraft, is available in contact combinations from single-pole, single-throw, up to three-pole, double-throw. It is claimed that this feature, combined with the large coil winding area, makes the series 345 an efficient relay in compact space. Dimensions are $2^{3}/_{8}$ by $2^{1}/_{32}$ by $1^{11}/_{16}$ in. Contacts, rated 12 amp. at 24 volts d.c., are arranged to resist over 10 g acceleration and vibration in all positions.

Coil resistances range from 0.01 to 15,000 ohms, in a varnish-impregnated and baked coil. Although standard voltages are 16 to 32, other values are available. The bearing is pin type, of hardened, nonmagnetic, stainless steel, and staked to the armature hinge. The armature return spring is torsion type to maintain an even spring pressure. Relay parts are plated to resist deterioration under conditions of high humidity. Guardian Electric Manufacturing Company, Chicago, Ill.

New A.C. Electrode

Coincident with their recent announcement of a new line of P&H a.c. industrial arc welders, the Harnischfeger Corporation has introduced a new all-position electrode designed especially for use with a.c. transformer welding machines. Suited for all mild steel applications, it is being made in the usual sizes of $^{1}/_{8}$, $^{5}/_{32}$, $^{3}/_{16}$, $^{1}/_{4}$, and $^{5}/_{16}$ in., and 14- and 18-in. lengths, packed in standard 50-lb. containers. Harnischfeger Corporation, Milwaukee, Wis.

Method of Rating Welding Current Output

A new "WSR" method of rating welding current output has been announced. By this system, the buyer or user is shown at a glance the exact minimum and maximum limits of a machine's usable welding current range. The primary function of "WSR" (Welding Service Range) ratings is to eliminate all guesswork in determining the loads a machine can or cannot handle. They are a development of the present method of rating and, according to the manufacturers of P&H Welding Machines, the only company using the system today, they can be applied to any make of welder. Up to now, they say, the practice has been to give the machines a nominal rating only, for example, 300 or 400 amp. and the buyer had to discover for himself the machine's actual ability. Until he did so, he was unable to make an equitable comparison of values with other machines on a delivered performance basis.

While the present rating system may be adequate in many installations, the advantages of "WSR" are described as obvious, especially under present conditions restricting availability of equipment. "WSR" ratings eliminate misunderstanding and confusion as to a machine's actual capacity; their adoption involves no changes in basic welder design but simply a new amperage-calibration plate. Harnischfeger Corporation, Milwaukee, Wis.

...make "tremendous trifles" for today's mighty bombers!

LAUXITE RESINS
To Meet Specification:
AN-NN-P511b
PHENOL RESIN
Lauxite PF10
MELAMINE RESIN
Lauxite MX
Lauxite MU
Lauxite 9-2C plus
250L Hardener
•
AN-G8
UREA RESIN
Lauxite 77X
Lauxite 947MX
•
CS-45-42
PHENOL RESIN
Lauxite PF4

WOOD-GLUE RELEASE STEEL FOR WAR

HUNDREDS of subcontractors are turning out highly essential "small items" to go into giant bombers and other fighting aircraft—using wood-and-Laucks-Glues.

These sub-assemblies for aircraft include: fuselages, nacelles, instrument and floor boards, seats, flaps, wings, tail assemblies, bomb-bay doors and spars.

No matter how small the job—no matter what your method of production—if you're using glue, call on America's Glue Headquarters for counsel, supplies and service.

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CHAMPION SPARK PLUGS . . .

. . are thoroughly dependable. This has been their outstanding characteristic for 33 years. Today Champions are on active duty on every front, adding daily to their prestige and reputation with the men of the air force.

C26S—Shielded

OFFICIAL U. S. NAVY PHOTOGRAPH

C26—Unshielded

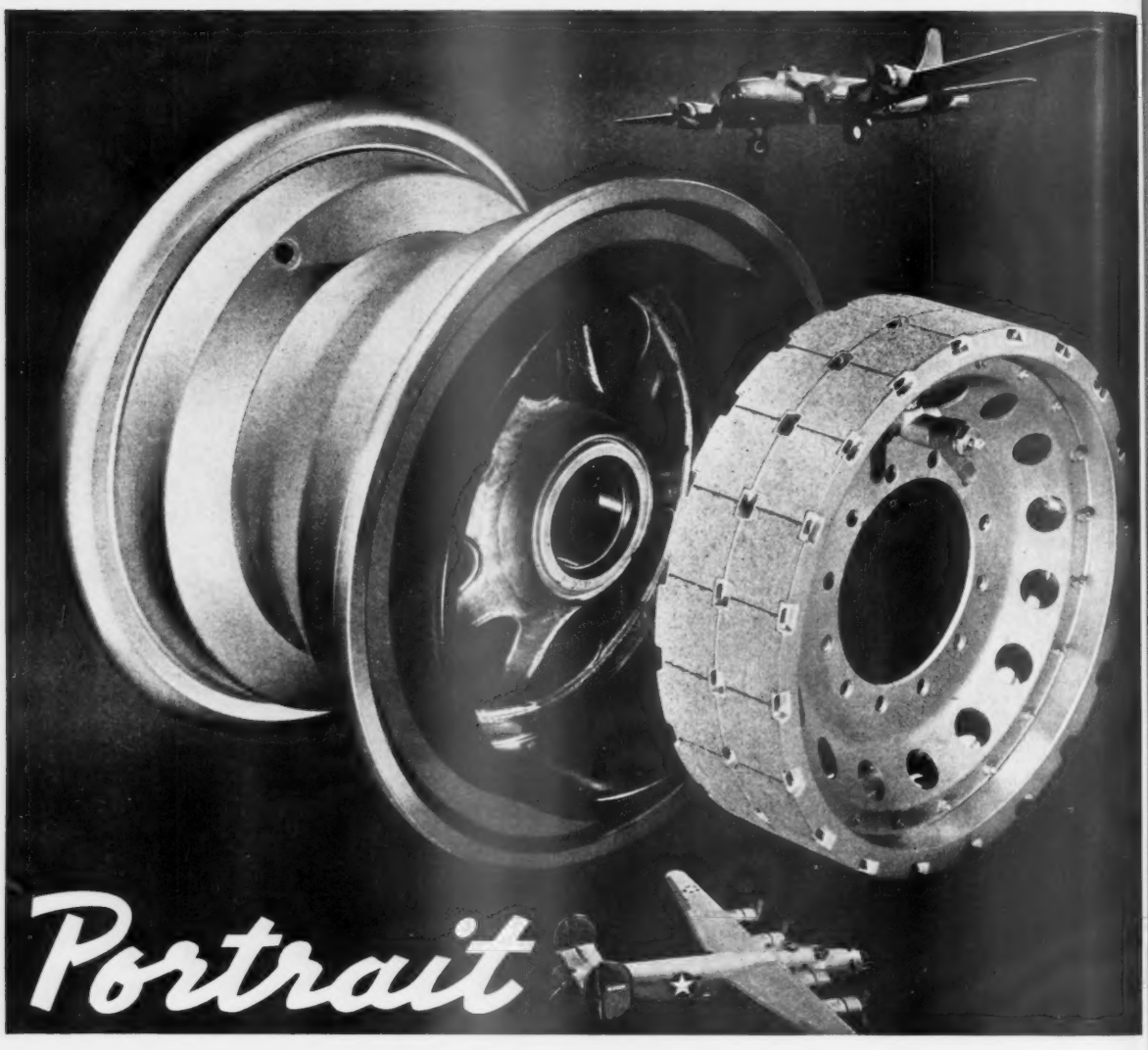
In aircraft engines of every type and size, dependable performance is the most desirable quality.

Spark plugs can and should contribute materially to the dependability of every engine by delivering their life-giving sparks regardless of temperatures or pressures. Champion Spark Plugs have compiled an outstanding record in this respect, and are playing their vital part in an ever-increasing number of all types of planes in use by our air forces.

Champion's unequalled resources are back of the specially developed ceramic insulating material used in these spark plugs. Exclusive features in construction and design are combined with its outstanding qualities, and account for their superior performance and dependability. Characteristic advantages of Champion Ceramic Insulation in service are:

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

USE CHAMPIONS AND FLY WITH CONFIDENCE



OF A "CREW MATE" THAT STARTS A FLIGHT . . . AND ENDS IT

"THE PORTRAIT" *Hayes Aircraft Wheel and Expander Tube Brake as used on the C-46 and other ships. Boeing B-17 Flying Fortress and Consolidated B-24 Liberator (illustrated) are also Hayes equipped.*

Slugging fight or routine flight—Hayes Wheels and Brakes mean accurate ground control in getting the ship off and landing it . . . last to leave the ground and first on the return.

War-tested in combat and training, as well as by the Air Transport Command and nation-wide airline operators, Hayes Wheels and Brakes rate "E" for Economy and Efficiency — in low maintenance cost, low cost per landing, stamina under punishing operation, ease of maintenance in the field—as well as accuracy of control under the gruelling ground variables of sand, steel, concrete or snow.

Representatives: *Eastern . . . J. Henry Reisner, Hagerstown, Md.*
Western . . . Airsupply Co., 5959 W. 3rd St., Los Angeles.

HAYES AIRCRAFT WHEELS AND BRAKES . . .

HAYES INDUSTRIES, INC. **Home Office: JACKSON, MICHIGAN, U. S. A.**

Machine Cleans Entire Aircraft Engine in One Operation

Development of a new cabinet-type cleaning machine to simplify and speed the movement of aircraft engines on the production line has been completed. Uniform and continuous cleaning is obtained by the use of a turntable designed to hold the engine and its assembly stand as it comes off the production line. This turntable revolves at 4 to 6 r.p.m. to complete the wash, rinse, and drying operations on one engine in about 20 min.

Wash and rinse solutions are applied through one set of spray pipes that extend completely around the engine and its stand. First wash water, then rinse water, is pumped on the engine parts, after which heated, high-velocity air is ejected through the blow-off nozzle, to dry the excess water from the engine surfaces.

The machine is 13 ft. high and is sunk 4 ft. below floor level to conserve space and to facilitate loading. The engine and its stand can be loaded directly into the machine without any lifting. It is also adaptable to airfield use—on teardowns and assembly of engines and to wash smaller separate parts in baskets placed on the turntable. Howard Engineering and Manufacturing Company, Cincinnati, O.

Aircraft Switches

When flight testing airplanes and conducting other special tests, multiple gang switches are often desirable. For this application, the maker offers Model 37S7, a three-gang switch, each with 18 points, and an off position.

When photographic observers are used, it is possible to locate the switch remotely with an indicating dial on the photographic panel to show the switch position for each picture. Drilling dimensions are the same as for the standard 3-in. case.

Other combinations of gangs and numbers of points are available and any type of connector may be used.

Another new aircraft switch is designated as Part 9S, a two-point switch, integrally mounted with the indicator. The Lewis Engineering Company, Naugatuck, Conn.

Instrument Flying Equipment

Polaroid instrument flying equipment consists of transparent colored sheeting that is attached to cockpit windows and transparent colored goggles worn by the student pilot. Wearing the goggles, the student pilot can read his instruments but cannot see outside the cockpit. The instructor, who does not wear the goggles, has an unimpeded view of ground, sky, other planes, instruments, and pilot.

The Fairchild AT-21 advanced trainer.

The equipment is designed to avoid the risk of collisions and other accidents caused by having the instructor flying wholly or partially blind. It dispenses with opaque hoods and curtains that limit the instructor's field of view. While the student flies on instruments, the instructor can see outside the cockpit and protect the plane from outside hazards.

The combination of goggles and sheeting acts as a one-man blackout system because of the color selectivity of the two plastics used. The sheeting is Polaroid Blind Flying (Green) Sheeting, which transmits only green light, blocking all other colors. The goggles are Polaroid Red Goggles, fitted with a lens that transmits only red light. The red and the green colors are precisely formulated and carefully controlled so as to be mutually exclusive. While it is easy to see through either the sheeting or the goggles separately, it is impossible to see through the combination. Polaroid Corporation, Cambridge, Mass.

Pressed Metal Institute

The Pressed Metal Institute, organized recently by some 60 representatives of sheet and strip metal fabricators, rolling mills, and metal-press manufacturers serving the industry will cooperate closely with appropriate Government departments to speed up and increase production of war materials, and it will also engage in research to develop new and extended uses for metal stampings in the postwar period.

Leaders in the metal industry believe that only by united effort, exchange of data, and pooling of experience can maximum results be obtained, and the institute was organized for those purposes. It is believed that through this association the industry will accomplish much more than individual concerns working alone could possibly achieve.

The Pressed Metal Institute has plans for broadening the scope of its war usefulness and has developed a constructive, well-organized approach to postwar manufacturing problems. In addition to its administrative offices at 19 West 44th Street, New York, it has established an office at the Press Building, 14th and F Streets, N. W., Washington, D.C., so that continuous contact will be maintained with Government departments responsible for production of war materials.

Two classes of membership have been established. Any fabricator of sheet or strip metal and any stamping manufacturer, whether producing stampings for his own use or for resale to other manufacturers, are eligible for active membership. Suppliers of raw materials such as steel, brass, and aluminum and also suppliers of equipment, such as presses, dies, tools, etc., are eligible as Associates.

George E. Whitlock, President of Mullins Manufacturing Corporation, Warren, O., is President of the Pressed Metal Institute; S. J. Menzel of Motors Metal Manufacturing Company, Detroit, is Vice-President; and H. L. Moody of Stevenson, Jordan & Harrison, New York, is Secretary-Treasurer and Managing Director. Pressed Metal Institute.

Thyratron Dynamometer

A specially designed dynamometer with many unusual features has been developed for testing new aircraft pumps. This machine is the invention of Electric Products Company, which built the unit to specifications drawn up by the engineering department of Pesco. It obtains its direct current from thyratron tubes.

It traveled more than 99.9% of the way on gasoline

This is a 37-mm. shell just about to complete the last five hundred yards of a five-hundred-mile journey from an American air base to the innards of a Jap Zero.

It got its last burst of speed from a charge of smokeless powder. But most of the way this shell, and the cannon that fired it, the pilot that aimed it and the plane that carried it—all four—were "propelled" by a gasoline engine.

That's why gasoline quality means so much in warfare today. The better the gasoline, the more power engine-builders can design into their engines—and the more shells and bombs we can place where they'll do the most good.

On its own initiative our petroleum industry has for years been engaged in research to improve aviation fuels and methods of producing them. The result is that today American refiners can supply our fighting forces with vast quantities of high-octane aviation fuel.

There is a generous portion of Ethyl antiknock fluid in all U. S. "fighting grade" gasoline. Added to the high quality gasoline produced by modern methods, it boosts its octane (antiknock) rating still higher. Today this super-gasoline "with Ethyl" is helping America fight. Tomorrow, with Victory, it will contribute to American commercial supremacy in the air.

ETHYL
BRAND OF ANTIKNOCK COMPOUND
ETHYL CORPORATION
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ETHYL CORPORATION
Chrysler Building, New York City

Manufacturer of Ethyl fluid, used by oil refiners to improve the antiknock quality of aviation and motor gasoline.

The thyratron is a mercury-filled rectifier tube, the output of which may be controlled by grids inside the tube. A magneto, which is chain-driven from the motor shaft, generates a voltage proportioned to the motor speed and is used as a tachometer to indicate the motor speed on a meter dial. The voltage is also introduced into the input of a vacuum tube amplifier and, after it has been amplified, it is used to control the grids of the thyratron tubes. By this means, the motor speed can be maintained at any fixed setting regardless of changes in load or line voltage.

Another feature is the selector switch which has a number of positions. By adjusting a screw for each switch position, the speed for that position may be set to any predetermined value desired. Pump Engineering Service Corporation, Cleveland, O.

Student Project in Airplane Testing

Nineteen Purdue University seniors in aeronautical engineering are being provided an opportunity for extra-curricular practical work through the establishment of a new student project sponsored by the Purdue Research Foundation in cooperation with Howard B. Morrow, President of the Morrow Aircraft Corporation.

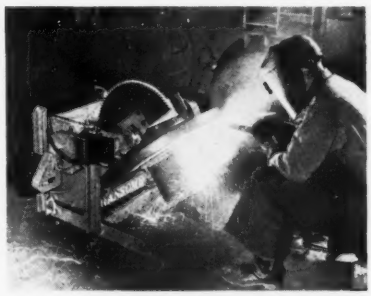
The seniors, all planning to be aeronautical engineers, are devoting from 8 to 15 hours per week outside their regular classroom and laboratory work conducting the static tests of a new type of high-performance, two-place, pilot-training airplane developed by Morrow engineers.

In conducting the tests of the Morrow trainer, a complete static-test airplane has been set up in the new airplane structures laboratory of the University's school of aeronautical engineering. The student work involved includes not only the static tests but also considerable drafting, stress analysis, and aerodynamic calculations.

The first flying model of the new airplane has been flown to the Purdue University airport from California in order to conduct the required Government flight tests. Several of the students have volunteered to serve as flight-test engineers in connection with the project. It is expected that the testing work will be completed this summer in order that application may be made for a Government license to place the plane in commercial production. Purdue University, Lafayette, Ind.

Welding Positioner

A new 500-lb. capacity welding positioner has the center of gravity of load 6 in. away from the table top and a 6-in. eccentricity.



The Ransome welding positioner.

The positioner is available in hand- or motor-operated models and is particularly suited to work ordinarily handled by women welders. The motorized unit includes a Reeves variable-speed drive providing a speed range of up to one revolution of the table top per minute. Tilting range is a full 135° from horizontal or 45° beyond vertical, providing the "down under" position for all downhand welds.

The 26-in. diameter circular table top is T-slotted to simplify the clamping of work to it. All gears are of the cut-tooth type. The machine can be furnished with a regular base for bench work or with a sub-base giving a height adjustment from 27 to 42 in. from the floor line to the table top. A clutch arrangement permits free rotation of the table top by hand when required. The motorized units can be supplied with a hand wheel in lieu of a motor for tilting if desired. Ransome Machinery Company, Dunellen, N.J.

Roebling Aircord Division

The establishment of a separate department to serve the aircraft industry, to be known as the Aircord Division, will make available through a single source the complete line of Roebling products for aircraft, as well as engineering and consulting service for the aircraft industry. The new department was made necessary by the growing needs of the industry and the increasing part that Roebling products are playing in it.

The aircraft industry has for years been an important user of Roebling products and engineering skill. The company was identified with the development of many new constructions of wire rope and aircraft control cord and improvements in the design of slings and fittings. Many of the developments with which it was associated are now restricted by military secrecy. Typical, however, is the special construction known as Lock-Clad Control Cord, on which the company worked with Lockheed Aircraft Corporation, the originator, to develop this type and get it into production. John A. Roebling's Sons Company, Trenton, N.J.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Bennett-Feragen Aircraft Brake Tester

A new Bennett-Feragen aircraft brake tester has been developed for the accurate measurement of brake force. It is designed to determine actual stopping distances, to reveal landing gear strut distortion, to detect tire weaknesses, to eliminate taxi tests, to equalize brakes, and to set up standards for correct stopping and proper adjustments.

The operating principle of the tester permits duplication of actual brake service conditions and allows brakes to be tested at their maximum capacity. Wheels are cradled between pairs of revolving rollers, which are so constructed as to provide friction surfaces equivalent to that of the tire on dry concrete. The rollers turn the wheels against normal running friction. When the brakes are applied, the force required to turn the wheels against the brake resistance is registered on the dials. This reading is the actual braking force existing between the tire and ground surface.

Two sizes of the brake tester are available: one machine with 36 in. rolls has a capacity up to 22,000 lbs. plane weight; the other with 72 in. rolls has capacity up to 80,000 lbs. plane weight. Both machines are equipped for testing brakes at two speeds and are adjustable for any width landing gear. The roll frames may be moved in either direction in a pit. Roll frames are mounted on parallel tracks in the pit to facilitate easy movement. Gauges fold under when not in use. Hinged plates cover exposed parts of the pit and mount flush with the apron surface. Anchorage posts hold the plane in position during heavy brake applications. Safety Equipment Company, South Bend, Ind.

Half-Wave Type Rectifier

A rectifier of the half-wave type with characteristics that have been rendered permanently stable is a recent addition to the Emby instrument and relay selenium rectifiers line.

A special forming process is credited with giving this rectifier (called the N type) a long life. Working tempera-

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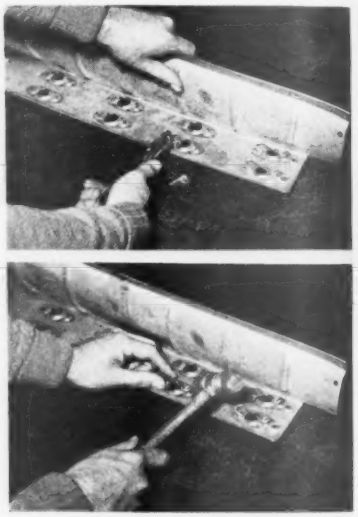
ture range extends from −70° to +75°C., and a negative temperature coefficient is exhibited. All associated equipment, such as meters, relays, etc., have positive temperature coefficients with resulting compensation when used with selenium rectifiers.

The N-2 consists of two rectifying elements $^{5}/_{32}$ in. in diameter assembled in a tubular plastic case and rated 10 volts a.c. The 20-volt a.c. unit will, therefore, consist of four rectifying elements, and rectifier rated 40 volts a.c. will consist of a rectifier stack of eight elements. D.c. rating for continuous load is 1 milliampere for instantaneous load, 3 milliamperes.

Impedance in the forward direction is of the order of 1,000 ohms. Impedance in reverse direction is of the order of 1 megohm per plate. Selenium Corporation of America, Los Angeles, Calif.

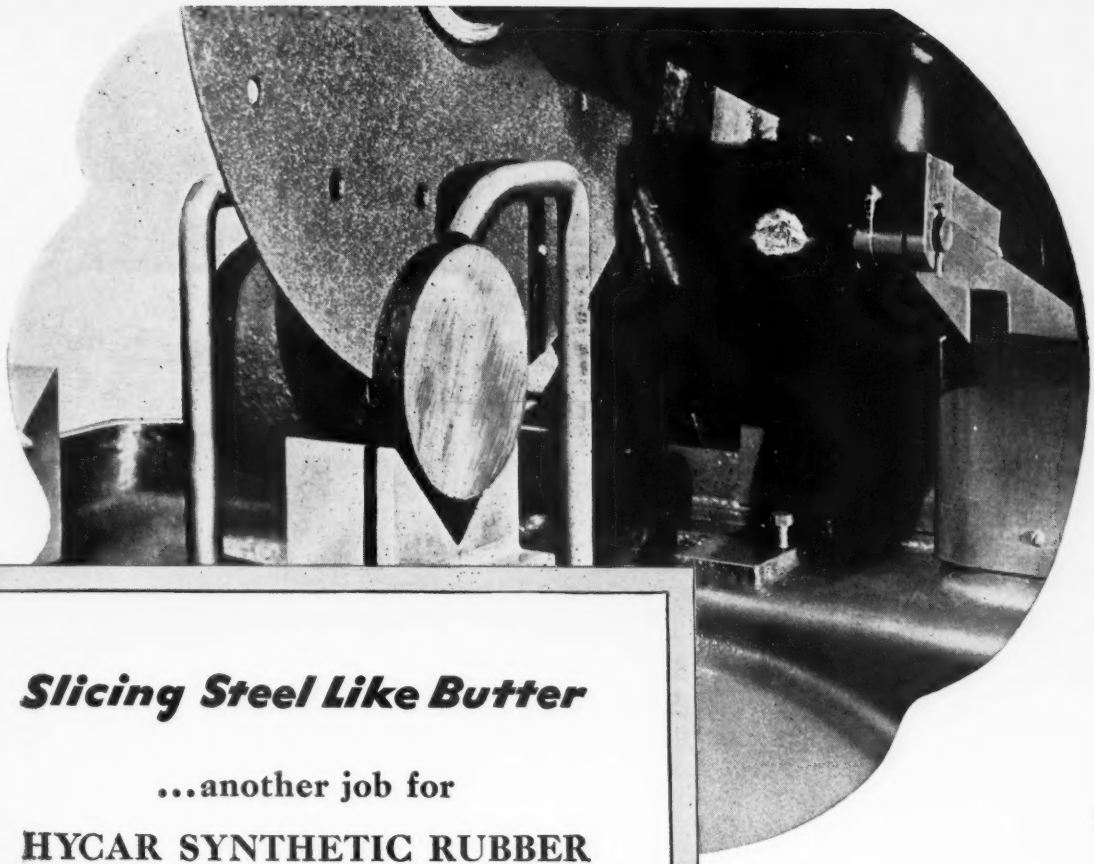


(*Top*) Removing "Dzus-type" spring from "Soloc" retainer without drilling. (*Bottom*) Replacing "Dzus-type" spring in "Soloc" retainer without riveting.

Spring Retainer

With the patented Soloc retainer, which is permanently secured by spot welding, the Dzus-type spring can be quickly snapped into position. A hammer or screw driver are the only tools required, and sometimes fingers alone suffice.

A broken Dzus-type spring can be lifted out of the Soloc retainer with pliers or by hand, and a new spring can be speedily put in place. The retainer is designed to eliminate the need for drilling out old rivets and inserting new ones. It does not require skilled labor for the job and tends to prevent damage to the airplane's structure. Solar Aircraft Company, San Diego, Calif.



Slicing Steel Like Butter

...another job for HYCAR SYNTHETIC RUBBER

HIGH-SPEED abrasive cut-off wheels that walk through heavy steel bars in a few seconds . . . this is not a place where you would expect to find synthetic rubber, but it's just one of thousands of ways Hycar has been used to improve essential products and processes throughout industry.

As the tough, durable bond that holds the particles of abrasive together in a cutting wheel, Hycar withstands the deteriorating effects of heat and oil-emulsion coolants, thus lessening wear and prolonging life of the wheel.

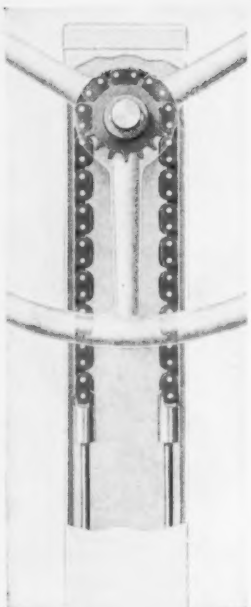
Resistance to oil—heat—abrasion . . . the qualities responsible for the superior performance of Hycar in this exacting service, are the identical qualities needed in many aircraft applications. In addition, Hycar offers aviation the vitally important advantages of light weight and low-temperature flexibility. All these qualities are blended in their proper proportions for fuel cells and hose, hydraulic seals and diaphragms, gaskets, grommets, rings and packing. For Hycar's wide usefulness lies in its ability to be tailor-made to fit the needs of each individual job. *Hycar Chemical Company, Akron, Ohio.*

Hycar is made in several types, supplied to fabricators in the form of crude synthetic rubber. We will be glad to work with you and your rubber products supplier in applying Hycar to your problems.

hycar

LARGEST INDEPENDENT PRODUCER OF BUTADIENE SYNTHETIC RUBBER IN AMERICA

How LINK-BELT Chains are Serving the Aircraft Industry

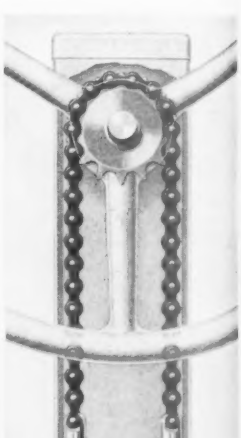


⬅ NEW AIRCRAFT SILENT CHAIN

A 3/8" pitch silent type chain designed especially for aircraft service. Compact, light in weight and of high tensile strength, this chain minimizes the effect of chordal action giving the maximum in smoothness of operation and making possible a reduction in loads required to operate controls. It is positive in action (no slip), highly efficient and flexible. Aircraft engineers have found its features doubly important in their design work, with the result that it is finding wide acceptance on applications on fighting, training and cargo-carrying planes.

AIRCRAFT ROLLER CHAIN ➡

A precision built chain that combines great strength with light weight and good wearing qualities. It is flexible, dependable, shock resisting. Runs in either direction on either side and can be wound back and forth to operate several shafts in the same or opposite directions.



⬅ 3/16" Pitch Silent Type Chain

A midget in size—but a giant in performance. This chain is serving the aircraft industry in various applications, such as rudder and aileron controls; cowl flap controls; for retracting landing gears; on gun mounts and gun turrets; and wherever conditions require a chain to operate in limited spaces.

LINK-BELT COMPANY
220 S. Belmont Ave., Indianapolis, Ind.

A NEW AIRCRAFT CHAIN DATA BOOK •

Send for this engineering data book. It has been especially compiled for designers and builders of aircraft of all types. For the first time, all the engineering information necessary to design silent chain or roller chain into aircraft controls is given in this one book. Write on your company's letterhead. Book No. 1825.

LINK-BELT
AIRCRAFT
PRECISION BUILT
SILENT AND ROLLER
CHAINS

9163

Porcelain Enameling of Exhaust Systems

The problem of adequately rust-proofing aircraft-engine exhaust manifold systems and mufflers has been solved and includes the elimination or reduction of the possibility of failures in or near welds caused by comparatively high-stress concentrations that normally accompany the welding of S.A.E. 1025 steels. One of the major causes of cracks has been charged to a combination of stress concentration and continued vibration of off-center loads at elevated temperatures.

Consultation with engineers of one of the largest manufacturers of bathtubs and other porcelain products resulted in the equipment of Taylorcraft Army liaison planes with porcelain-enameled exhaust and muffler systems. The new interior and exterior porcelain coating developed for the present S.A.E. 1025 steel exhaust system is claimed to save critical materials and make a product of good appearance and durability.

In addition to the abrasion-resisting, moisture-resisting and rust-proofing qualities, the heat used in firing the porcelain coating is useful in stress-relieving the welded joints into a more homogeneous unit, and the porcelain outer coating holds the heat long enough to reanneal the exhaust unit after each run of the engine.

The coefficient of expansion of this heavy coating seems to be near that of steel, since there is no sign of cracking even when the material is heated to 1,600°F. in the porcelaining process. The cost factor is nominal and the weight increase in the particular unit mentioned is only about 1 lb. Taylorcraft Aviation Corporation.

"Multilaminar" Wing Spar

The multilaminar wood wing spar being used in the Taylorcraft liaison airplanes for the Army was developed by the Forest Products Laboratory, in conjunction with the Radio Corporation of America and a number of the country's leading lumber companies, notably the Tolerton Lumber Company of Alliance. This method of "wood welding" makes possible the utilization of various-sized planks that formerly would have been discarded as scrap in the making of airplane wing spars. The method also permits the use of flat-sawed, panel-cut, and quarter-sawed wood in the laminations.

The material situation required the engineers of airplane manufacturers to make an intense search for the correct answer to the problem of how to obtain the fullest possible utilization from the rapidly declining stocks of airplane wood. They have found the solution, in part, in the multilaminar process.

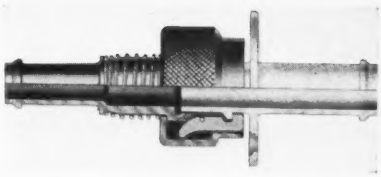
The Radio Corporation of America contributed its services through a means of cutting the time of "welding" laminated wood, and a special radio-connected press was designed. The press is operated hydraulically, a copper plate over a sturdy cushioning plank of lumber forming its lower shelf and a similar copper-covered shelf being raised and lowered by hydraulic jacks from above. A third copper plate is placed between two sets of spar metal. A high-tension power line connects the center of the copper plate with the transmitter, which is practically a duplicate of a radio broadcasting unit.

To make the Taylorcraft multilaminar spars, 6-in. square blocks are sawed lengthwise into $^3/_4$-in. planks, smoothed and shaped at the ends to form the wing spars. The result, in appearance, is the same as if eight or nine $^3/_4$-in. square strips of wood, each about $16^1/_2$ ft. long were glued together, one on top of the other. A front wing spar of eight to nine laminations, $^3/_4$ to $^7/_8$ in. in thickness, $6^1/_2$ in. wide, and $16^1/_2$ ft. long, can be twisted more than 180° without causing any damage or deterioration to the wood.

The Taylorcraft Army liaison plane weighs 1,300 lbs., fully loaded. In recent static tests Taylorcraft engineers placed weights of 5,000 lbs. on a wing panel containing multilaminar spars. This is equivalent to 10,000 lbs. over the plane's total wing surface. The spars took it without damage. Taylorcraft Aviation Corporation.

Disconnect Couplings

It is announced that new applications of the Wiggins Quick Disconnect Couplings are being made by aircraft designers and technicians for connecting fuel, oil, and cooling lines, as well as lines used for fluid instruments, air, and vacuum. They are also being used in engine-test cells and other ground equipment and can be applied at any place where a quick, tight connection is needed.

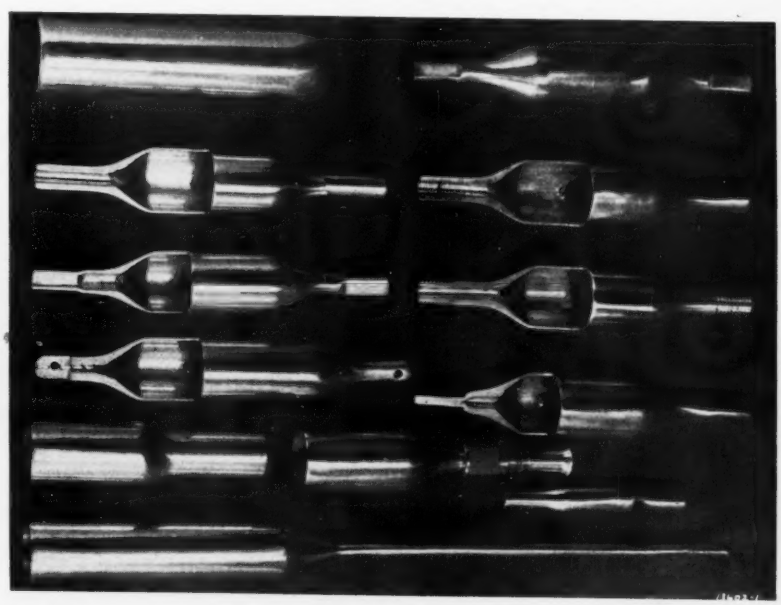


The Wiggins quick disconnect coupling.

A quick pull on the knurled ring instantly disengages the coupling. By placing the two ends of the coupling together and pushing lightly on the knurled ring, an immediate, tight connection is made. The couplings are used in inaccessible places where a wrench cannot be turned. They are intended to eliminate the possibility of cross threading, loose connections, and abraded gaskets.

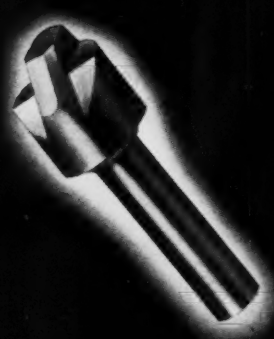
The couplings have been tested from 0 to 500 lbs. pressure and to 29-in. Hg. vacuum. They are said to be satisfactory for use with 100 octane gasoline, high aromatic fuels, engine lubricating oils, and cooling fluids at an extremely wide range of temperatures.

Light in weight, machined from aluminum, they are available in sizes from $^3/_8$ to 2 in., inclusive. Nipples or flanges for special connections can be obtained. Additional models of single and double self-sealing couplings are also available. Wiggins Quick Disconnect Couplings Division of E. B. Wiggins Oil Tool Company, Inc., Los Angeles, Calif.



Samples of types of tube closures made by the Wolverine tube end spinning process. (*See* page 119.)

ANOTHER PROBLEM SOLVED BY SCOVILL COLD-FORGING SKILL WITH IMPORTANT SAVINGS IN MATERIALS–MONEY–MOTIONS



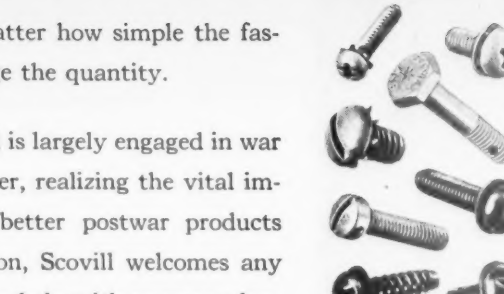
"Know how" proof #11 . . . more each month

Scovill produced the above part in quantity from alloy steel wire with but four operations—head, re-head, trim and turn. No matter how different your fastenings problem from this important war production job, it will benefit from the cold-forging "know how" that solved it.

This wide range of Scovill standard fastening devices also benefit from this same engineering ingenuity. Customers find that the skill that licks the tough ones insures extra uniformity and satisfaction no matter how simple the fastening or large the quantity.

Today Scovill is largely engaged in war work. However, realizing the vital importance of better postwar products and production, Scovill welcomes any opportunity to help with postwar planning problems (or current needs) to the limits its present commitments permit. Call in the Fastenings Expert in the nearest office listed below for a prompt, frank answer as to where and when we can serve you.

To the Reader: **Kindly pass this advertisement on to any of your associates whom we may be able to serve. Thank you!**



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NEW YORK, Chrysler Building • DETROIT, 6432 Cass Avenue • CHICAGO, 1229 W. Washington Boulevard • PHILADELPHIA, 18 W. Chelten Avenue Building
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Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

Aero Digest, 515 Madison Ave., New York City, $3.00.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York City.

Aerodrome Abstracts, compiled by the Department of Scientific and Industrial Research, and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1.

Aeronáutica, Avenida de Mayo 1370, Buenos Aires, Argentina, Pesos 4.50.

Aeronáutica Argentina, Cassilla de Correo 1897, Buenos Aires, Argentina, Pesos 8.00.

Aeronautics, Tower House, Southampton St., London, W.C.2, 27*s.*

Aeronautics (Quarterly), 37 W. 45th St., New York City, $1.00.

The Aeroplane, Bowling Green Lane, London, E.C.1, 61*s.*

The Aeroplane Spotter, Bowling Green Lane, London, E.C.1, 8*s.* 8*d.*

Air Facts, 30 Rockefeller Plaza, New York City, $3.00.

Air Force, U.S. Army Air Forces, 101 Park Ave., New York City.

Air Force Review, 31 Willcocks St., Toronto, Canada, $3.00.

The Air Line Mechanic, 6250 S. Kedzie Ave., Chicago, Ill.

The Air Line Pilot, 3145 W. 63rd St., Chicago, Ill.

Air Mail Magazine, Newport, Monmouthshire, England, 5*s.*

Air News, 545 5th Ave., New York City, $1.50.

Air Progress, 79 7th Ave., New York City, $2.50.

Air Tech, 545 5th Ave., New York City, $2.50.

Air Trails, 79 7th Ave., New York City, $2.00.

Air Transportation, 10 Bridge St., New York City, $5.00.

Air-Age, 160 W. Broadway, New York City, $0.90.

Aircraft, 62 Flinders St., Melbourne, C.1, Australia, 16*s.*

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, 26*s.*

Aircraft Journal, United Aircraft Corp., East Hartford, Conn.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, £1 14*s.* 6*d.*

Aireports, 515 Madison Ave., New York City.

The Airesearcher, Airesearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif.

Airflow, Casey Jones School of Aeronautics, Jackson Heights, New York, and Newark, N.J.

Airlanes, 333 W. 57th St., New York City, $2.50.

Airpost Journal, Albion, Pa., $2.00.

Alert, Goodyear Tire & Rubber Company, Akron, O.

Allisonews, Allison Division, General Motors Corporation, Indianapolis, Ind.

Aluminum News Letter, Aluminum Co. of America, Pittsburgh, Pa.

Amarillo Field Mecha News, Ewing Publishing Co., 2812 W. 6th Ave., Amarillo, Tex.

American Association for the Advancement of Science, Bulletin, Smithsonian Institution Bldg., Washington, D.C., $1.00.

American Aviation, 1317 F St., N.W., Washington, D.C., $3.00.

American Aviation Daily, 1317 F St., N.W., Washington, D.C.

American Aviation Sky-Gest, American Aviation Corp., Jamestown, N.Y.

American Import and Export Bulletin, 10 Bridge St., New York City, $5.00.

American Machinist, 330 W. 42nd St., New York City, $5.00.

The American Mercury, 570 Lexington Ave., New York City, $3.00.

American Meteorological Society, Bulletin, Milton, Mass., $3.50.

The American Pilot and Aircraftsman, 225 S. Church St., Charlotte, N.C., $2.00.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York City, $12.00.

Anahuac, Talleres N. de C. A., Balbuena, D.F., Mexico, $6.00 (Mex.).

A.O.P.A. Section, Aircraft Owners & Pilots Assn., 1424 Walnut St., Philadelphia, Pa.

Army News, Bureau of Public Relations, War Dept., Washington, D.C.

Army Ordnance, 705 Mills Building, Washington, D.C., $4.50.

A.S.T.M. Bulletin, American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., $1.50.

Astronautics, 130 West 42nd St., New York City, $3.00.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia, Pa., $1.00.

Automotive News, 5229 Cass Ave., Detroit, Mich., $4.00.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit, Mich.

Avia, Belgrano 471, Piso 3°, Buenos Aires, Argentina, $6.00 *m/n.*

Aviacão, R. Uruguiana 104, 4°, Rio de Janeiro, Brazil, *Rs.* 70$000.

Aviation, 330 W. 42nd St., New York City, $3.00.

Aviation Equipment, 1170 Broadway, New York City.

Aviation Progress in Los Angeles County, Board of Supervisors of Los Angeles County, Los Angeles, Calif.

Aviation Service Magazine, Machinery Hall, 549 W. Washington Blvd., Chicago, Ill.

The Aviatrix, Women's National Aeronautical Assn., Tulsa Loan Bldg., Tulsa, Okla.

Bakelite Review, Bakelite Corp., 30 E. 42nd St., New York City.

The Bee-Hive, United Aircraft Corp., East Hartford, Conn.

The Beech Log, Beech Aircraft Corp., Wichita, Kan.

Bell Laboratories Record, 463 West St., New York City, $2.00.

The Bell Ringer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N.Y.

Bladesman, Curtiss-Wright Corp., Propeller Division, Caldwell, N.J.

Boeing Contact; Boeing Plane Talk, Boeing Airplane Co., Wichita, Kan.

Boeing News, Boeing Aircraft Co., Seattle, Wash.

The Bombsight, Advanced Flying School, Army Air Forces, Kirtland Field, N.M.

Breeze American, Breeze Corporations, Inc., 41 S. 6th St., Newark, N.J.

Brewster Builder, Brewster Aeronautical Corporation, Northern Boulevard at 35th, Long Island City, N.Y.

British Airways News Letter, British Overseas Airways Corp., Airways House, London, S.W.1.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York City, $4.50.

Bulletin of Technical Data for the Plywood Industry, The Resinous Products & Chemical Co., Washington Sq., Philadelphia, Pa.

Caminos del Aire, Pan American Airways, Bolivar 18, México, D.F.

Canadian Air Cadet, 122 Wellington St., Ottawa, Canada, $1.00.

Canadian Aviation, 481 University Ave., Toronto, 2, Canada, $2.50.

Cessquire, Cessna Aircraft Co., Wichita, Kan.

The Chance Vought News, Chance Vought Aircraft Division, United Aircraft Corp., Stratford, Conn.

Civil Aeronautics Journal, U.S. Government Printing Office, Washington, D.C., $0.50.

Civil Air Patrol Bulletin, Office of Civilian Defense, Washington, D.C.

Civil Air Patrol Bulletin, Wisconsin Wing 62, Civil Air Patrol, 110 E. Wisconsin Ave., Milwaukee, Wis.

Civil Air Patrol Courier, Missouri Wing 73, Civil Air Patrol, Kratz Field, St. Louis, Mo.

Cockpit Clatter, Aircraft Owners and Pilots Assn., Carpenters Bldg., Washington, D.C.

Colliers, The Crowell-Collier Publishing Co., Springfield, O., $3.00.

Commercial Aviation, 919 Tramways Bldg., Montreal, Canada, $3.00.

Construction Glues, I. F. Laucks, Inc., 911 Western Ave., Seattle, Wash.

Contact, Air Lines Terminal Bldg., New York City, $2.00.

Culver's Going Places, Culver Aircraft Corp., 600 E. 35th St., Wichita, Kan.

Current Aviation, 400 S. Front St., Columbus, O., $0.80.

Curtiss Fly-Leaf, Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y.

Curtiss-Wright-er, Curtiss-Wright Corp., Lambert Field, St. Louis, Mo.

Daggett News, Douglas Aircraft Company, Inc., Daggett, Calif.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York City, $3.00.

Douglas Airview, Douglas Aircraft Co., Inc., Santa Monica, Calif.

The Draftsman, 171 Madison Ave., New York City, $3.00.

The Dragon, The Fafnir Bearing Co., New Britain, Conn.

The Eagle, Consolidated Vultee Aircraft Corp., Fort Worth, Tex.

Eastern Aircraftsman, Eastern Aircraft Div., General Motors Corp., Linden, N.J.

The Eaton News, Eaton Mfg. Co., 739 E. 140th St., Cleveland, O.

The Edo Log, Edo Aircraft Corp., College Point, N.Y.

El Segundo Airview News, Douglas Aircraft Company, Inc., El Segundo, Calif.

The Engineer, 28 Essex St., Strand, London, W.C.2, £3 3*s.*

Enid Plane Facts, Enid Army Flying School, Enid, Okla.

The Exchangite, 335 Superior St., Toledo, O., $1.00.

Fairchild Engineering News, Fairchild Aircraft Division, Fairchild Engine and Airplane Corp., Hagerstown, Md.

The Faircrafters, Fairchild Aircraft, Burlington, N.C.

Flagship News, American Airlines, Inc., New York Municipal Airport, Jackson Heights, L.I., N.Y.

Fleetwings' Arrow, Fleetwings, Bristol, Pa.

Flight, Dorset House, Stamford St., London, E.C.1, £3 1*s.*

Flying Cadet, 420 Lexington Ave., New York City, $1.00.

Flying; Industrial Aviation, 540 N. Michigan Ave., Chicago, Ill., $3.00.

The Flying M, Menasco Mfg. Co., 805 S. San Fernando Blvd., Burbank, Calif.

The Foundation, The Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich.

Franklin Institute, Journal, Philadelphia, Pa., $6.00.

General Aircraft News, London Air Park, Feltham, Middlesex, England.

Glider Progress, California Aero Glider Co., 1829 West 62nd St., Los Angeles, Calif.

Global Service Log, Lockheed and Vega Aircraft Corporations, Burbank, Calif.

Globe Beam, Globe Aircraft Corp., North Side Station, Fort Worth, Tex.

GM Folks, General Motors Corp., Detroit, Mich.

Goodrich Circle; The Goodrich Silvertown News, The B. F. Goodrich Co., Akron, O.

Great Britain, Aeronautical Research Committee, Reports and Memoranda, British Information Services, 30 Rockefeller Plaza, New York City.

Group 514 News, Civil Air Patrol Group 514, Cleveland Municipal Airport, Cleveland, O.

Heat Treating and Forging, Box 447, CPO, Pittsburgh, Pa., $2.00

Heath Beacon, Heath Company, Benton Harbor, Mich.

The Hecker Michronicle, A. W. Hecker, 1976 E. 66th St., Cleveland, O.

High Pressure, Walter Kidde & Co., 140 Cedar St., New York City.

Indian Aviation, 13 Ezra Mansions, P. O. Box 2361, Calcutta, India, *Rs.* 7/8.

Industrial and Engineering Chemistry, Industrial Edition, 1155 16th St., N.W., Washington, D.C. $4.00.

Institute of Transport, Journal, 15 Savoy St., London, W.C.2, 10*s.* 4*d.*

Institute of Welding, Transactions, 2, Buckingham Palace Gardens, London, S.W.2, 32*s.*

The Intava World, International Aviation Associates, Artillery House, Artillery Row, London, S.W.1.

The Intercontinent News, Intercontinent Aircraft Corp., Miami, Fla.

Interstate-ments, Interstate Aircraft and Engineering Corp., 3443 Wilshire Blvd., Los Angeles, Calif.

Jefferson Barracks Hub, Air Forces Basic Training Center, Jefferson Barracks, Mo.

Journal of Applied Mechanics, 29 W. 39th St., New York City, $5.00.

Journal of Aviation Medicine, 2642 University Ave., St. Paul, Minn., $5.00.

Journal of Research of the National Bureau of Standards, U.S. Government Printing Office, Washington, D.C., $3.50.

Journal of Scientific Instruments, The University, Reading, Berkshire, England, 33*s.*

Journal of the Aeronautical Sciences, 1505 RCA Building West, New York City, $7.00.

The Kearns Post Review, Air Forces Basic Training Center, Kearns, Utah.

Keep 'Em Flying, The Miami Herald, Miami, Fla.

The Learavian, Lear Avia, Piqua, O.

Library Bulletin of Abstracts, Universal Oil Products Co., 310 S. Michigan Ave., Chicago, Ill.

The Light's Beam, Lights, Inc., Alhambra, Calif.

The Listening Post, Information and Filter Center Workers, Aircraft Warning Center, First Fighter Command, Mitchell Field, N.Y.

The Lockheed-Vega Aircraftsman; The Lockheed-Vega Log; The Lockheed-Vega Star, Lockheed Aircraft Corp., Burbank, Calif.

Long Beach Airview News, Douglas Aircraft Company, Inc., Long Beach, Calif.

Luftschutz, Schweizerischer Luftschutzverband, Seidengasse 8, Zürich, Switzerland, Sw. Fr. 3.00.

The Lycoming Star, Lycoming Division, Aviation Corporation, Williamsport, Pa.

MAC Weekly Bulletin, McDonnell Aircraft Corp., Lambert Field, St. Louis, Mo.

Machine Tools, National Machine Tool Builders Association, Cleveland, O.

The Martin Star, The Glenn L. Martin Co., Baltimore, Md.

Mechanical Engineering, 29 W. 39th St., New York City, $6.00.

Mechanical Topics, The International Nickel Co., Inc., 67 Wall St., New York City.

Metals and Alloys, 330 W. 42nd St., New York City, $2.00.

The Military Surgeon, 7th and Independence Ave., Washington, D.C., $4.00.

Model Airplane News, 551 5th Ave., New York City, $2.00.

Model Aviation; Including Air Youth Horizons, Air Youth Division, National Aeronautic Association, 1025 Connecticut Ave., Washington, D.C., $1.00.

Modern Plastics, 122 E. 42nd St., New York City, $5.00.

Modern Transport, 105 Strand, London, W.C.2, 20*s.*

The Monthly Honker, Canadian Pacific Air Lines, 620 Dominion Sq. Bldg., Montreal, Canada.

Monthly Science News, 3 Hanover St., London, W.1.

Monthly Weather Review, U.S. Government Printing Office, Washington, D.C., $2.00.

Mundo Aeronáutico, Rivadavia 945, Buenos Aires, Argentina, Pesos 4.00.

National Aeronautics, 1025 Connecticut Ave., Washington, D.C., $3.00.

The N.A.T.A. Dispatch, National Aviation Training Assn., 214 E. Armour Blvd., Kansas City, Mo.

New Horizons, Pan American Airways System, 135 E. 42nd St., New York City.

New York University, Contributions from the College of Engineering, University Heights, New York City.

News Digest, Hill & Knowlton, 350 5th Ave., New York City.

Nickel Cast Iron News; Nickel Steel Topics; Nickelsworth, International Nickel Co., 67 Wall St., New York City.

Noorduyn Tale-Spin, Noorduyn Aviation Ltd., 1411 Crescent St., Montreal, Canada.

North American Skyline; North American Skywriter, North American Aviation, Inglewood, Calif.

North Ameri-Kansan, North American Aviation, Fairfax, Kansas City, Kan.

Northeast Airlines Gremlin, Northeast Airlines, Inc., Commonwealth Airport, Boston, Mass.

Northrop Life; The Northrop News, Northrop Aircraft, Hawthorne, Calif.

The Northwest Airlines Beam, Northwest Airlines, 1885 University Ave., St. Paul, Minn.

Observation Post, Ground Observer Corps, Aircraft Warning Service, First Fighter Command, Mitchel Field, New York.

The Official Foreign Air Mail Guide, 11 W. 42nd St., New York City, $1.50.

The Official Guide of the Airways, 608 S. Dearborn Ave., Chicago, Ill., $5.00.

Ohio State University, Engineering Experiment Station News, Columbus, O.

The Ohmite News, Ohmite Mfg. Co., 4835 Flournoy St., Chicago, Ill.

Oklahoma City Douglas Airview News, Douglas Aircraft Company, Inc., Oklahoma City, Okla.

Pacific Aeronautical Library, Bulletin, 6715 Hollywood Blvd., Hollywood, Calif.

Parks Air News, Parks Air College, East St. Louis, Ill.

The Pegasus, Fairchild Engine & Airplane Corp., 30 Rockefeller Plaza, New York City.

Pesco News, Pump Engineering Service Corp., Borg-Warner Corp., Cleveland, O.

The Pick-Up, All American Aviation, Inc., 209 W. 9th St., Wilmington, Del.

Picture News, Sinclair Refining Co., 101 W. 51st St., New York City.

Plane Talk, Consolidated Vultee Aircraft Corp., 3301 Empire State Bldg., New York City.

The Polar Tech, The Argus-Leader Co., Sioux Falls, S.D.

Popular Science Monthly, 353 4th Ave., New York City, $2.00.

Production Equipment, 328 S. Jefferson St., Chicago, Ill.

Production Information, Automotive Council for War Production, New Center Bldg., Detroit, Mich.

Protar, Schweizerischer Luftschutz Verband, Solothurn, Switzerland, Sw., fr. 12.—.

Ranger's Cloud Buster, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corp., Farmingdale, N.Y.

Republic Aviation News, Republic Aviation Corp., Farmingdale, N.Y.

The Resinous Reporter, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia, Pa.

Revista Aérea Latino Americana, Aeronautical Digest Publishing Corp., 515 Madison Ave., New York City, $1.00.

Revista de Aeronáutica, Ministerio del Aire, Juan de Mena 8, Madrid, 100 Pesetas.

Revista de la Fuerza Aérea, Ministerio de Defensa Nacional, El Bosque, Santiago de Chile.

Revista do Ar, Aero Clube de Portugal, Avenida da Liberdade 226, Lisbon, 72$00.

The Rohm & Haas Reporter, Rohm & Haas Co., Washington Sq., Philadelphia, Pa.

Rotol Digest, Technical Library, Rotol Airscrews, Ltd., Gloucester, England.

Royal Aeronautical Society, Journal, 4, Hamilton Place, London, W.1, £3 3*s.*

The Royal Air Force Quarterly, Ideal House, Argyle St., Oxford Circus, London, W.1, 23*s.*

Ryan Flying Reporter, Ryan Aeronautical Company, San Diego, Calif.

The Saturday Evening Post, Independence Square, Philadelphia, Pa., $3.00.

Schweizer Aero-Revue, Schanzenstrasse 1, Bern, Switzerland, Sw. Fr. 10.00.

Scientific American, 24 W. 40th St., New York City, $4.00.

The Scrapper, Conservation Division, War Production Board, 420 De Soto Ave., St. Louis, Mo.

Service Engineering, Kent-Moore Organization, Inc., 485 W. Milwaukee, Detroit, Mich.

The Shaft, Summerill Tubing Co., Bridgeport, Pa.

Sheet Metal Industries, 49 Wellington St., Strand London, W.C.2, 10*s.*

Shell News; Shell Progress, Shell Oil Co. 59 W. 50th St., New York City.

Simmonds Aeronews, Simmonds Accessories, 21–10 49th Ave., Long Island City, N.Y.

Skyways, 30 Rockefeller Plaza, New York City, $3.00.

Soaring, Box 71, Elmira, N.Y., $2.00.

S.A.E. Accelerator; S.A.E. Journal, 29 W. 39th St., New York City, $10.00.

S.B.A.C. Press Summary, Society of British Aircraft Constructors, 32 Saville Row, London, W.1.

Sociedad Cubana de Ciencias Fisicas y Matematicas, Revista, Universidad de la Habana, Cuba, $3.00.

The Solar Blast, Solar Aircraft Co., Lindbergh Field, San Diego, Calif.

Southern Flight, 1901 McKinney Ave., Dallas, Tex., $2.00.

Spartan School News, Spartan School of Aeronautics, Municipal Airport, Tulsa, Okla.

Speed, Western Airlines, 510 W. 6th St., Los Angeles, Calif.

The Sperry News; The Sperryscope, Sperry Gyroscope Co., Manhattan Bridge Plaza, Brooklyn, N.Y.

The Sportsman Pilot, 515 Madison Ave., New York City, $3.00.

The Stabilizer, The Lincoln Electric Co., Coit Rd. & Kirby Ave., Cleveland, O.

Steam Car Developments and Steam Aviation, Nestling House, Sleights, Whitby, England, 12*s.*

Steel Horizons, Allegheny Ludlum Steel Corporation, Pittsburgh, Pa.

The Stewart-Warner Worker, Stewart-Warner Corp., 1827 W. Diversey Pky., Chicago, Ill.

The Stinsonair, Stinson Division, Vultee Aircraft, Wayne, Mich.

Take-Off, North American Aviation, Dallas, Tex.

The Tale-Spinner, Army Air Forces Preflight School, San Antonio, Tex.

The Taylorcraft News, Taylorcraft Aviation Corp., Alliance, O.

Technical Data Digest, Matériel Center, Engineering Division, Army Air Forces, Wright Field, Dayton, O.

Technical Education News, McGraw-Hill Publishing Co., 330 W. 42nd St., New York City.

Technical News Bulletin of the National Bureau of Standards, U.S. Government Printing Office, Washington, D.C., $0.50.

Texaco Star, The Texas Co., 135 E. 42nd St., New York City.

Texacts, Army Air Forces Technical School, Sheppard Field, Tex.

To Keep 'Em Flying, Miami Beach Daily Tropics, Miami Beach, Fla.

Trade Winds, Wright Aeronautical Corp., Paterson, N.J.

Transatlantic Air News, American Export Airlines, 25 Broadway, New York City.

The T.W.A. Skyliner, Transcontinental & Western Air, Inc., 10 Richards Rd., Kansas City, Mo.

United Air Lines News, United Air Lines Corp., 5959 S. Cicero Ave., Chicago, Ill.

U.S. Air Services, Transportation Bldg., Washington, D.C., $3.00.

U.S. N.A.C.A. Technical Memorandums, N.A.C.A., Washington, D.C.

U.S. Steel News, U.S. Steel Corp., 436 7th Ave., Pittsburgh, Pa.

Universal Airline Schedules, 139 N. Clark St., Chicago, Ill., $5.00.

Universal Engineering Digest, Universal Trading Corp., 630 5th Ave., New York City.

Victory Bulletin, U.S. Government Printing Office, Washington, D.C., $0.75.

Vox Prop, American Propeller Corp., Toledo, O.

Vultair, Vultee Aircraft, Inc., Vultee Field, Calif.

The Vultee Volunteer, Nashville Division, Vultee Aircraft, Inc., Nashville, Tenn.

War Medicine, 535 N. Dearborn St., Chicago, Ill., $5.00.

War Production News, The B. F. Goodrich Co., Akron, O.

Washington News Letter, 1025 Connecticut Ave., Washington, D.C., $2.00.

The Wasp Nest, Pratt & Whitney Aircraft Div., United Aircraft Corp., Kansas City, Mo.

The Welding Journal, 33 W. 39th St., New York City, $5.00.

Welding News, National Electric Welding Machines Co., 1800 Trumbull St., Bay City, Mich.

West Coast Air Mail Society, Bulletin, 4142 26th St., San Francisco, Calif.

Western Flying, 304 S. Broadway, Los Angeles, Calif., $2.00.

Wheelco Comments, Wheelco Instruments Co., Harrison and Peoria Streets, Chicago, Ill.

Wil-Rich Forum, Wilcox-Rich Division, Eaton Manufacturing Co., 9771 French Rd., Detroit, Mich.

Wings, McGraw-Hill Publishing Co., 330 W. 42nd St., New York City.

Wright at the Moment, Wright Aeronautical Corporation, Paterson, N.J.

Salute to Memphis... *and its post-war future*

High on the Chickasaw Bluffs overlooking the mighty Mississippi, stands Memphis . . . historic, colorful, truly representative of the romantic river cities of the Old South. But considerations other than its charm governed our choice of Memphis as the site for additional aircraft manufacturing plant facilities.

Favorable climatic conditions, accessibility of location, adequate supplies of labor, exceptionally good electric, gas, and water facilities, enlightened and progressive civic and community leadership—all these are factors which influenced the location of a McDonnell Plant at the Memphis Municipal Airport.

Details concerning the type and performance of aircraft which will soon roll out on our runways—are of military necessity, restricted. But you may be sure that these aircraft will play an important role in hastening the day of victory for America and our Allies.

That's our job in Memphis, *now*. But one day, when victory has been won and peacetime transportation is resumed, this old river city will become an important *ocean port*—in the Ocean of the Air. Then, we hope to add our share to the contributions which Memphis and the *New South* will make to the New World of the Air.

McDONNELL *Aircraft Corporation*

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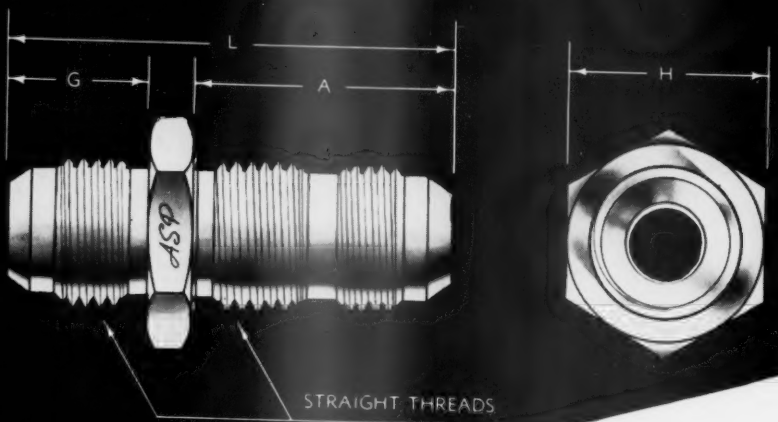

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PART NO.	TUBE NO.	T C						
UN-832- 2	2	1/8					/32	.39
UN-832- 3	3	3/16			.057	1	$2\frac{29}{64}$	.54
UN-832- 4	4	1/4	7/8–14	$1\frac{39}{64}$	.758	$1\frac{1}{4}$	$2\frac{23}{32}$	.67
UN-832- 5	5	5/16						
UN-832- 6	6	3/8	$1\frac{1}{16}$–12	$1\frac{25}{32}$	.864	$1\frac{7}{16}$	$3\frac{1}{32}$	.80
UN-832- 8	8	1/2						
UN-832-10	10	5/8	$1\frac{5}{16}$–12	$1\frac{25}{32}$	.911	$1\frac{11}{16}$	$3\frac{5}{64}$	1.20
UN-832-12	12	3/4	$1\frac{5}{8}$–12	$1\frac{53}{64}$	.958	$2\frac{1}{16}$	$3\frac{5}{32}$	1.50
UN-832-16	16	1						
UN-832-20	20	$1\frac{1}{4}$						

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ARMY–NAVY
AN-832

UNION-BULKHEAD

CATALOG NUMBER
UN-832

Institute News

Executive Vice-President of the Institute Honored

Major Lester D. Gardner, Executive Vice-President of the Institute, was given an honorary degree of Doctor of Laws at the Commencement Exercises of the Polytechnic Institute of Brooklyn, on Tuesday evening, June 2, at the Brooklyn Academy of Music, Brooklyn, N.Y.

Major Gardner was presented for his Doctor's degree by Mr. Charles E. Potts, Chairman of the Corporation, to Dr. Harry S. Rogers, President of the Polytechnic Institute.

Presentation by Mr. Potts:

Lester Durand Gardner, a native New Yorker, was educated at Massachusetts Institute of Technology and Columbia University and immediately entered the editorial field. He founded the publications, *Aviation* and *Aeronautical Engineering*, and then in the first World War was trained as an officer for the Signal Corps and rose to Major in the Air Forces. At the close of the war he returned to the field of publishing and to the promotion and development of aviation. Representing his country in numerous international conferences on aeronautics, he has been honored by international conventions and has received the Diploma of Honor of the League of International Aviators.

Recognizing the vital need for a learned society to support the professions and the industry of aviation, he was a prime mover in organizing the Institute of the Aeronautical Sciences, of which he is now the Executive Vice-President. He has promoted, developed, and directed the publications of the Institute and founded the Aeronautical Archives, the greatest of all libraries of aeronautics. He is a member of many military and aeronautical societies, holds the unique distinction of an Honorary Fellow of the Royal Aeronautical Society of London, and is dearly loved by all leaders in aviation.

In recognition of his great services to the aeronautical professions and to the aircraft industry and of his great vision, deep devotion, and high character, I present to you Lester Durand Gardner, for the degree, Doctor of Laws.

Major Gardner (*left*), and Russell Harrison Varian (*center*) with President Rogers.

Citation by President Rogers:

Lester Durand Gardner, you have made great contributions to the profession of aeronautical engineering and to the aircraft industries. Your broad vision of the service which a professional Institute, scientific publications, and comprehensive archives can contribute to an expanding industry and to its underlying sciences has inspired you through years of eminent achievement. The supporting institutions which in other professions have required generations of growth have flowered under your care and leadership within a few years. Your great energy and distinguished ability have contributed to the efficiency, the soundness, and the greatness of these institutions. For your accomplishments you have been honored and esteemed by your fellow workers; for your helpfulness, your integrity, and your high character you are dearly beloved.

In recognition of the eminence of your achievements and in deep appreciation of your spirit of service I confer upon you the degree, Doctor of Laws, with all its rights and privileges.

New Membership Dues

As the supply of paper for printing the publications of the Institute is limited, it must be used to render maximum service to all members. Some members have one or both publications available in their company libraries or from other sources so that these members pay for subscriptions they do not need.

The dues of members will no longer include the two publications, but all members will be privileged to subscribe to either or both publications of the Institute at half the regular subscription rates.

The Council of the Institute has revised the dues to meet the new conditions and the new plan will go into effect immediately for newly elected members and on October 1 for present members of the Institute. The dues rates approved for all grades of members are as follows:

Affiliates	$ 5.00
Technical Members	$ 5.00
MEMBERS	$ 9.00
Industrial Members	$ 9.00
Associate Fellows	$11.00
Fellows	$15.00

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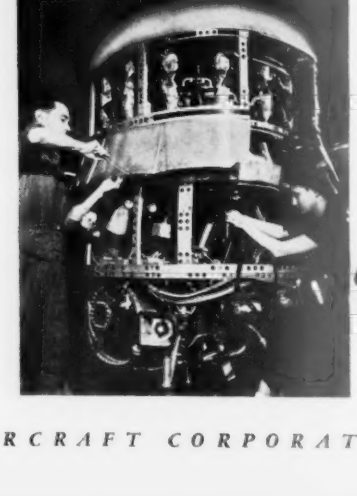

HELPING TO WRITE

THE STORY OF TOMORROW

ROHR AIRCRAFT CORPORATION • CHULA VISTA, CALIFORNIA

E. P. Warner Made Honorary Fellow of The Royal Aeronautical Society

Edward P. Warner, a Fellow of the Institute and Vice-Chairman of the Civil Aeronautics Board, was invited by The Royal Aeronautical Society to present the 31st Wilbur Wright Memorial Lecture in May. Mr. Warner accepted the invitation and chose as his subject "Postwar Transport Aircraft." While in London Mr. Warner was made an Honorary Fellow of the Royal Aeronautical Society.

The Royal Aeronautical Society is the oldest aeronautical organization in the world, having been founded in 1866. In the 76 years of its history it has elected only 17 men as Honorary Fellows. Of the 17, Mr. Warner's election makes the fifth American. The others have been: 1908, Mr. Orville Wright; 1920, Dr. J. C. Hunsaker, Chairman of the National Advisory Committee for Aeronautics; 1939, Major Lester D. Gardner, Executive Vice-President of the Institute; 1941, Mr. T. P. Wright, Director Aircraft Resources Control Office, War Production Board.

Aircraft War Production Council, East Coast, Inc.

More than 130 airplane, engine, and propeller experts, comprising the Board of Directors and nine committees of the Aircraft War Production Council, East Coast, Inc., met on May 28 at the Ranger Engine Division of Fairchild Engine and Airplane Corporation to coordinate production and man-power methods and provide further cooperation with military and Government officials.

Problems concerning engineering, materials, industrial relations, transportation, salvage, service, plant defense, public relations, and other phases of production were studied in individual meetings of the various committees, while the Board, composed of presidents of eight of the leading East Coast aircraft firms, made plans for expansion of Council facilities and duties. J. Carlton Ward, Jr., the new President of the Council, conducted the meeting. Lawrence D. Bell is the new Vice-President. Clyde M. Vandeburg, deputy director of the Office of War Information, was elected new general manager of the enlarged Council.

East Coast Council committees, which meet at least once a month to concentrate on expediting plane production, discussed at this quarterly all-committee session results of the materials meetings held in Washington recently with members of the Aircraft Production Board, W.P.B., and military materials officials. The engineering committee reported that, since November, 1942, 364 exchanges of engineering reports, data, etc., have been made between the companies, with the West Coast Council, and with other manufacturers who are not members of the Council. Industrial training was discussed and exchanges of methods were put into effect, following Council procedure. Other subjects included fuel rationing, production systems, servicing of equipment in combat zones, salvaging of materials used in plane construction, and plant security measures.

E. P. Warner

Members of the Council include Aviation Corporation, Bell Aircraft Corporation, Brewster Aeronautical Corporation, Curtiss-Wright Corporation, Curtiss-Wright Propeller Division, Eastern Aircraft Division of General Motors, Fairchild Engine and Airplane Corporation, Lycoming and Liquid-Cooled Divisions of Aviation Corporation, American Propeller Corporation, The Glenn L. Martin Company, Ranger Engine Division of Fairchild, and Republic Aviation Corporation.

Buffalo Section Donates $500 to Army Air Forces Aid Society

The previous issue of the REVIEW announced that any excesses over expenses of the preorganization meeting of the Buffalo section of the Institute would be donated to the Army Air Forces Aid Society.

Following the meeting, an excess of $500 remained after all expenses had been paid. As the Institute is a nonprofit organization, a check for this amount was forwarded to Gen. H. H. Arnold for the Army Air Forces Aid Society. The letter of acknowledgment from Gen. H. H. Arnold follows:

Gentlemen:

I received from Mr. Lester D. Gardner a check in the sum of $500 representing an excess obtained during a meeting of the Buffalo Section.

This check was made out to be payable to the Army Air Forces Relief Fund, the correct title of which is Army Air Forces Aid Society, and I accept with pleasure this sum of money to be applied to the permanent fund for the aid of Army Air Forces personnel and dependents after the war.

I wish to assure you that great benefits will accrue from this and other similar donations when the time comes for its use.

Thanking you again, I am

Sincerely,

(Signed) H. H. ARNOLD
General, U.S. Army,
Command General, Army Air Forces

Gifts to the Aeronautical Archives

During the month a number of notable gifts was received. Brig. Gen. Frank P. Lahm gave a valuable collection of framed prints, letters, clippings and other material. The collection is of importance for the study of the history of American aeronautics and includes a leather-bound volume containing letters and affidavits collected by General Lahm's father, Frank S. Lahm, when investigating the fact that the Wright brothers really flew in 1904 and 1905. Besides Mr. Lahm's account of the investigation, the volume contains issues of "Gleanings in Bee Culture" and letters or affidavits from Orville Wright, O. F. Jamieson, T. H. Waddell, Howard W. Myers, William Webbert, Edgar W. Ellis, C. E. Taylor, and Frank Hamburger.

Orville Wright sent a large gift of newspaper clippings and sheet music for the "Wilbur Wright March," by Louis Teres, 1908, and "Song of the Wright Brothers," by Mrs. Mary E. Kurstman, 1909. This material adds greatly to the large collections of the Wright brothers in the Archives.

Mrs. Bella C. Landauer gave an interesting print, "Lofty Projects," London, 1825, and added sheet music and other items to the generous collections previously given.

Miss Matilda Moisant gave a unique book of clippings of John Moisant's winning of the $10,000 Statue of Liberty race on October 30, 1910, taken from contemporary sources.

Dr. James H. Means contributed several copies of the *Aeronautical Annual* and copies of the pamphlets *Control for Flying Machine*, 1913; *Manflight*, 1891; *20th Century Energy*, 1896; and *Problem of Manflight*, 1894, by his father, James Means.

The Curtiss-Wright Corporation, Propeller Division, gave a portfolio of colored prints of "Fighting Aircraft

194X WEEK-END

The war is speeding *many* developments which will contribute not only to peacetime employment, but to a fuller life when war is over. Among these will be family planes that are simple to fly, dependable and economical. Important accelerator of this progress will be the constant speed, lightweight Wickwire Automatic Propeller with its *fully* automatic pitch change.

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Here are the facts on non-eroding hose

Looking for hose or hose assemblies that withstand solvents?...that won't clog hydraulic mechanisms?...that will twist and flex?...stand practically any conditions or abuse?

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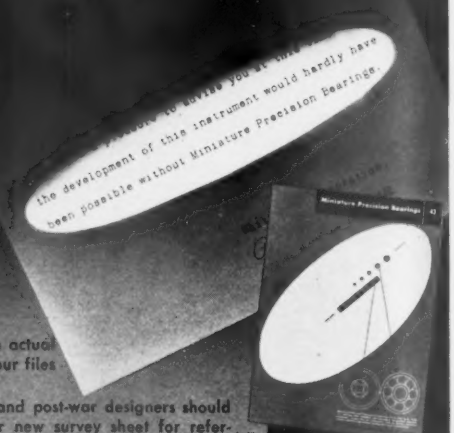
ANSWER to an engineer's dream:



"From an actual letter in our files

Present and post-war designers should have our new survey sheet for reference. Ask for Bulletin AR-7-43. Complete specifications and interesting information on these tiny precision bearings.

MINIATURE *Precision* BEARINGS

KEENE, NEW HAMPSHIRE, U·S·A

of America." The Osborne Company gave several examples of colored decorations for aeronautical calendars. Rotol Airscrews, Ltd., sent a *Catalogue of the Technical Library*. Mr. A. Leo Stevens added many prints, clippings, magazines, and other items to the collections previously given, including a striking medal awarded to Mr. Stevens on September 3, 1900, by the Atlantic Coast Railway Company.

The Division of Aeronautics of the Library of Congress gave a bound set of the collected *Aeronautical Papers* of Dr. Albert F. Zahm, in five volumes.

Another valuable addition to the collection of early source material on aeronautics came also from the Division of Aeronautics. This was more than 3,600 typewritten pages of the correspondence of Octave Chanute, transcribed from the originals.

Insignia

Through the generosity of aircraft companies, air lines, and aeronautical organizations, the collection of insignia has expanded greatly during the past few months and has become the most complete collection of its kind in the country. Additions will be made to the collection as they become available. A list of the air-line insignia now on exhibit in the Aeronautical Archives follows:

All American Aviation, Inc.

Pilot's Wings (3 "A's" over blue and white enamel map)

American Airlines, Inc.

Brooch ("AA"—dull gilt, round)
Cap Button ("AA"—gilt)
DC-3 Lapel Pin ("American"—nickel)
Employee's Identification Badge ("American Airlines, Inc.")
Mechanic's Cap Insignia ("AA"—gilt, round)
Pilot's Cap Insignia ("AA"—bright gilt)
Pilot's Cap Insignia ("AA"—dull gilt)
Pilot's Wings ("AA"—gilt)
Service Lapel Pin, 1–5 Years ("AA"—silver)
Service Lapel Button, 5 Years ("AA"—gold)
Service Lapel Button, 10 Years ("AA"—gold, with diamond)
Stewardess' Cap Badge ("AA"—silver)
Stewardess' Wing Insignia, 5-Year Service ("AA"—gold)
Stewardess' Wing Insignia ("AA"—silver)
Uniform Button ("AA"—gilt)

American Export Airlines, Inc.

Pilot's Wings ("AE"—gilt, cloth)
Pilot's Wings ("AE" with 3 dashes under bird, wreath beneath, gilt on cloth)
Wing Insignia ("AE" on red, cloth)

Braniff Airways, Inc.

Cap Brooch ("Braniff Airways"—gilt)
Employee's Plant Admittance Badge ("Braniff Airways—The B Line")
Pilot's Wings ("Braniff Airways"—gilt)

Canadian Airways, Limited

Cap Brooch ("Canadian Airways, Limited" in circle surrounding goose in flight, gilt)

Canadian Colonial Airways

Pilot's Wings ("CCA" on green, gilt)

Canadian Pacific Air Lines

Cloth Insignia ("Canadian Pacific Air Lines" in white on blue and red shield, felt swatch)
Lapel Button ("CPA"—blue shield with silver wings, silver)
Pilot's Cap Badge ("Canadian Pacific Air Lines"—gilt wings in the shape of a circle, enclosing red and blue shield)
Pilot's 20 Ligne Epaulette Button ("C. P. Air Lines"—gilt)
Pilot's 26 Ligne Cap Button ("C. P. Air Lines"—gilt)
Pilot's 36 Ligne Tunic Button ("C. P. Air Lines"—gilt)
Pilot's Wings ("C.P.A."—blue shield with gold wings)

Catalina Air Transport

Pilot's Wings ("CAT"—gilt)

Chicago and Southern Air Lines, Inc.

First Officer's Insignia ("C and S"—gilt)
Hat Band ("Chicago and Southern")
Pilot's Identification Badge (photograph, plastic)
Pilot's Wings ("CSAL")—gilt)
Stewardess' Identification Badge ("C.S.A.L." 1160)
Uniform Button ("C & S—Dixie Lines Service"—Large)
Uniform Button ("C & S—Dixie Lines Service"—Small)

Continental Air Lines, Inc.

Brooch ("Continental Air Lines"—gilt on blue enamel)
Employee's Identification Badge ("Continental Air Lines, Inc.")
Hostess' Wings (Company Insignia, "Continental Air Lines, Hostess")
Lapel Button ("Continental Air Lines"—gold)
Pilot's Wings ("CAL"—gilt)

Czechoslovakia Air Line

Stick Pin (bird in circle, $^3/_8$ in.)

Delta Air Corporation

Brooch ("Delta Airlines"—gilt on blue and white enamel)
Pilot's Wings ("D" on blue, gilt on cloth)

Eastern Air Lines, Inc.

Arm Band ("Eastern Air Lines"—cloth)
Courier Cap Pin ("Eastern Air Lines"—silver, red bar)
Dispatcher Cap Pin (silver, green bar)
Employee's Identification Badge ("Eastern Air Lines")
Field Manager Cap Pin (silver, blue bar)
Ground Personnel Cap Button ("Eastern Air Lines"—silver)
Lady Agent's Pin ("Eastern Air Lines"—silver wings)
Mechanic's Uniform Shirt Swatch ("Eastern Air Lines"—cloth, 3 in.)
Pilot's Cap Button ("Eastern Air Lines"—gilt, old M.T.D. type)
Pilot's Wings ("Eastern Air Lines"—gilt braid on black cloth wings, old M.T.D. type)
Pilot's Wings ("Eastern Air Lines"—gilt)
Pilot's Wings ("Eastern Air Lines" on blue enamel, gilt on cloth, new type)
Service Lapel Button, 5 Years (gold wings, new type)
Service Lapel Button, 5 Years (blue bar with two diamonds, old type)
Service Lapel Button, 1 Year (silver wings, new type)
Service Lapel Button, 1 Year (blue bar with two stars, old type)
Transportation Agent Cap Pin (silver, black bar)
Uniform Cap Swatch ("Eastern Air Lines"—cloth, 2 in.)

Inland Air Lines, Inc.

Pilot's Wings ("IAL" on blue, gilt, cloth)

K.L.M.

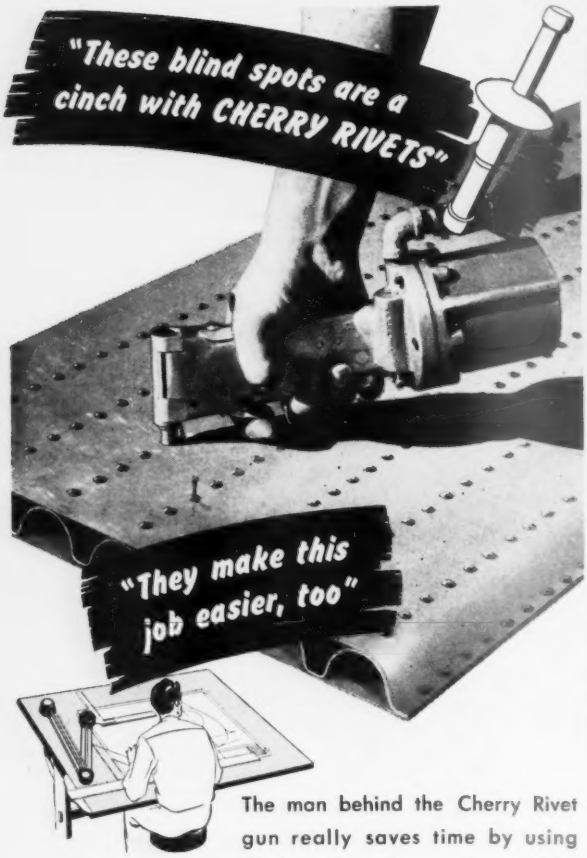
Lapel Pin ("K.L.M."—gilt, wings surmounted by crown)

Maine Central Airlines

Pilot's Wings ("M.C.A."—cloth)

Mid-Continent Airlines, Inc.

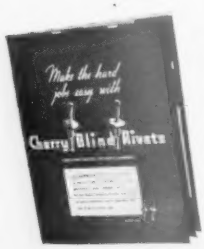
Employee's Identification Badge



The man behind the Cherry Rivet gun really saves time by using Cherry Rivets wherever it would be difficult to use a bucking bar. And he turns out a better job . . . thanks to the positive mechanical action which is an important feature of the Cherry Rivet.

To the engineer these rivets mean even greater advantages. He can now design up to efficiency rather than down to a manufacturing limitation. The high shear and fatigue values and the excellent shank expansion of Cherry Rivets eliminate the necessity of designing away from blind spots in both primary and secondary structures.

Get the complete story on Cherry Rivets. Sizes, styles of rivets, application techniques and riveting tools are fully described in the Handbook A-43. Request your copy from Dept. A-105, Cherry Rivet Company, Los Angeles, California.



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Cherry Rivet
Company
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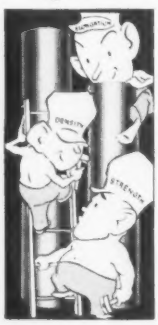
THE aviation engineer who is looking for additional facilities to produce cylinder liners, bearings, rings, sleeves, seats, etc., will find that Shenango-Penn centrifugally cast products offer many advantages.



The process assures greater strength and purity and a fine, even grain structure not obtained in ordinary castings. Cylinders from 2″ to 26″ O.D. and up to 26 ft. in length can be furnished. Flanges and unusual shapes and sizes can be worked out. Machining time is reduced because there is less allowance for finish required.

Shenango-Penn's research and engineering experience are at your disposal to help solve any problems that will speed up production. We'll gladly send you our new Bulletin No. 143, or can have a representative call if you want immediate information.

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SHENANGO - PENN

("Mid-Continent Airlines, Inc.")
Service Lapel Pin, 2 Years ("M.C.A.")
Service Lapel Pin, 5 Years ("Mid-Continent Airlines"—DC-3 on white)
Pilot's Wings ("Mid-Continent Airlines"—blue enameled Indian aiming arrow)
Stewardess' Cap Insignia (half wing, gold)

National Airlines, Inc.

Cap Brooch ("National Airlines"—"NAL" on white pennant)
Cloth Insignia ("National Airlines")
Cloth Insignia ("National Airlines Air Mail")
Pilot's Wings ("National Airlines"—"NAL" on white pennant)

North East Airlines

Pilot's Wings ("NEA" on blue with pilgrim, gilt)

Northwest Airlines, Inc.

Cloth Insignia ("Northwest Airlines")
Lapel Pin (DC-3 with "Northwest Airlines" on wings, gilt)
Passenger Agent Lapel Pin ("Northwest Airways—Passenger Agent")
Pilot's Wings ("NWA" on blue, gilt on cloth)
Service Lapel Pin, 1 Year ("Northwest Airlines U. S. Air Mail"—gilt)
Stewardess' Wings ("Northwest Airlines U. S. Air Mail"—half wing, gilt)
Uniform Button (U.S. seal, gilt, new type)
Uniform Button (wings over propeller, gilt, old type)

Pan American Airways System

Compañia Nacional Cubana De Aviación

Airport Manager's Wings (map of Cuba in oval, signal flags crossed beneath, blue on gilt)
Flight Personnel Cap Insignia (round, map of Cuba in oval, blue on gilt)
Pilot's Breast Wing (map of Cuba in oval, two stars beneath, blue on gilt)
Pilot's Cap Insignia (map of Cuba in circle, blue on gilt)
Radio Mechanic's Breast Pin (map of Cuba in oval, lightning flash below, blue on gilt, half wing)
Traffic Manager's Insignia (map of Cuba in oval, "Trafico" beneath, blue on gilt, half wing)

Lloyd Aereo Boliviano

Pilot's Cap Insignia ("L.A.B."—gilt, 3 in.)
Pilot's Breast Wings ("L.A.B."—gilt, 2 in.)
Service Lapel Pin ("L.A.B."—gilt, $^3/_4$ in.)

Pan American-Grace Airways, Inc.

Flight Officer's Breast Pin (round map of South America in circle, horizontal propeller over engine, green and gilt)
Lapel Pin ("Grace"—South America in circle, right wing, gilt and green, $^3/_4$ in.)
Passenger's Souvenir Flight Pin ("Panagra")
Pilot's Cap Insignia (wreath with large South American map in circle, green and gilt, $1^1/_2$ in.)
Pilot's Wings (map of South America in circle and three stars below, green and gilt, $2^1/_4$ in.)
Flight Purser's Breast Pocket Pin ("Purser"—map of South America in circle, green and gilt, $1^1/_2$ in.)
Radio Mechanic's Breast Pin (map of South America in circle with lightning flash below, green and gilt)

Pennsylvania-Central Airlines Corporation

Cap Brooch ("PCA" on red Keystone, gilt)
Pilot's Wings ("P.C.A."—gilt)
Stewardess' Wings ("PCA" on red Keystone, gilt, single wing)

Trans-Canada Air Lines

Cap Brooch ("TCA"—green gilt maple leaf)
Employee's Identification Badge ("Trans-Canada Air Lines No. 536")
Employee's Identification Cards ("No. 999 and 1000")
Mechanic's Cap Badge ("T.C.A."—gilt)
Pilot's 26 Ligne Uniform Button ("T.C.A."—gilt)
Pilot's Wings ("T.C.A."—gilt)
Stewardess' Cap Badge ("T.C.A."—silver)
Stewardess' 25 and 36 Ligne Uniform Buttons ("T.C.A."—silver)

Transcontinental and Western Air, Inc.

Cap Brooch ("TWA"—Indian head, dull gilt)
Pilot's Wings (Indian head on wing, gilt)
Service Lapel Button, 5 Years ("T.W.A."—silver)
Service Lapel Button, 10 Years ("T.W.A."—gold)
Stewardess' Wings ("T.W.A."—on red enamel, half wing, gilt)

Transportes Aereos Centro-Americanos

Pilot's Wings (gilt)

United Air Lines Transport Corporation

Cap Insignia ("United Air Lines, Coast to Coast"—silver and gilt on black cloth)
Dispatcher Wing Breast Pin (silver, company shield in center and bar beneath "Dispatcher")
Limousine Driver Wing Breast Pin (silver wings with company shield and bar beneath "Limousine")
Passenger Agent's Wing Breast Pin (silver wings with company shield in center and bar beneath "Passenger Agent")
Pilot's Wings ("United Air Lines" silver shield on cloth)
Porter's Cap Band ("United Air Lines, Coast to Coast"—embroidered in silver and gilt on red cloth)
Porter's Wing Breast Pin (silver wings with company shield in center and bar beneath "Porter")
Service Lapel Pin, 1 Year (silver wings, with shield and propeller "United Air Lines")
Shop and Hangar Employees' Cap Ornament (shield embroidered in red, white, and blue "United Air Lines")
Station Manager's Wing Breast Pin (silver wing with company shield in center and bar beneath "Station Manager")
Stewardess' Breast Ornament (silver half wing with company shield "United Air Lines")
Stewardess' Cap Ornament (silver half wing with Company shield "United Air Lines")
Uniform Buttons, 24 and 36 Ligne ("United Air Lines, Coast to Coast")
Uniformed Personnel Cap Ornament ("United Air Lines, Coast to Coast"—embroidered in gilt and silver on black cloth)

Western Air Lines, Inc.

Cap Ornament ("W.A.L."—wings)
Lapel Pin ("Western Air Lines"—silver)
Lapel Pin ("Western Air Lines"—gold)
Pilot's Wings (blue "W"—enamel gilt)
Pilot's Wings ("Western Air Lines"—$3^1/_4$ in.)
Stewardess' Wings ("Western Air Lines"—2 in.)

Western Air Express

Pilot's Wings (Indian head on wings, no lettering, gilt)

Pilot's Wings ("WAE" on blue enameled Indian head, silver on cloth)

Deutsche Zeppelin - Reederei, G.M.B.H.

Lapel Pin ("Deutsche Zeppelin-Reederei"—blue globe with zeppelin on silver)

Corporate Member Restores Original Name

The Kellett Autogiro Corporation has reassumed the name of Kellett Aircraft Corporation, which was the original company name when it was founded in 1929. The name change was approved at a special meeting of stockholders held in Philadelphia on June 10, 1943, and became effective on June 15.

Return to the original company name became advisable because of the larger scope of aeronautical activities in which the company is currently engaged. Kellett is producing several types of rotary-wing aircraft and is manufacturing, as a subcontractor, important parts for military combat airplanes.

New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become Corporate Members of the Institute.

The Electric Auto-Lite Company has 17 divisions and subsidiaries. For many years one of the largest independent manufacturers of automotive electrical equipment, the company's resources and 22 plants today produce many products for aircraft use not directly concerned with the electrical system.

Auto-Lite manufacturing divisions have long contributed to the production and development of America's aircraft. The company's service to the aeronautical industry is based on more than 30 years of manufacturing and engineering accomplishment, in addition to modern and diversified production facilities, including a new million-dollar Aviation Products Division plant.

Products now being made for the Army and Navy and for leading aircraft users and manufacturers include the following: aluminum die castings, aircraft batteries, aeronautical instruments, electrical equipment and cables, plastics, and stampings.

The Jordanoff Aviation Corporation is engaged in the preparation of inspection, maintenance, and flight manuals for the Air Forces. A program of postwar services to the aircraft industry is being planned.

Phillips Petroleum Company has, since 1928, pursued an energetic research program on aviation gasoline directed toward the development of higher quality and improved processes.

The company is credited with having originated numerous advances in the production of aviation fuels and chemical processes for the refining of aviation gasoline.

A flying laboratory is operated by Phillips Petroleum Company for evaluating aviation fuels. The data thus obtained have proved useful to the armed services in their program.

Scott Aviation Corporation is at present concerned primarily with the manufacture of oxygen regulators—both manually operated and automatic. Its activities also branch out into the field of landing gear for light aircraft, gliders, and helicopters.

The company maintains its own foundry for aluminum-alloy sand castings. Castings produced in this foundry are used in its own production and in the production of other aircraft manufacturers. The engineering department is now at work on the development of improved oxygen equipment, airplane engine accessories, and aircraft equipment.

Sections and Branches

San Diego Section

The San Diego Section held a meeting on Friday, April 23, 1943. There were over 200 members and guests in attendance.

A commercial picture was shown on a newly developed alloy, titled *The All Purpose Metal*, followed by the picture, *Pearl Harbor*.

The guest speaker of the evening, Capt. Frank T. Courtney, presented a review of the development of the flying boat, from its early stages 29 years ago to the present-day version, closing with an opinion as to the future of that type of airplane.

Seattle Section

Seven Section meetings were held during the year. That more meetings were not held was due to the difficulty in obtaining speakers who were definitely able to arrange their time sufficiently in advance to insure their appearance.

At the May 5 meeting, W. H. Baihly spoke on his experiences as a Boeing Service Engineer in North Africa, and George Sanborn told of his experiences and impressions while assigned as a Boeing Service Engineer in England.

Aeronautical University

At a meeting on April 20, a member gave a summary of his technical paper on "Plexiglas." During the meeting on May 4 meteorology was discussed.

The final meeting of the current term was held on June 8. Officers elected for the coming term are: Carl Breed, Chairman; Cass Hurc, Vice-Chairman; and James Guske, Secretary-Treasurer.

The winners of the Branch's technical papers contest were announced. William Engel, now in the armed services, won first prize with a paper on the use of Diesel engines in aircraft.

University of Detroit

The University of Detroit Student Branch held its final meeting for the year 1942–1943 during the month of March. Four theses, written by some of the senior students, were presented in outline form.

The theses and the authors are: "Liquid-Cooled or Air-Cooled Aircraft Engines," by R. F. Keuper; "An Investigation of the Feasibility of a New Type Helicopter," by Leonard Majewski; "Torsion Test on a Tapered Monocoque Fuselage," by E. Gurry and C. W. Fredericks; and "The Strength Characteristics of Aircraft Plywood," by Ian Gray and C. B. Rogers.

The following new officers were elected for 1943–1944: Chairman, Paul Brinich; Vice-Chairman, Gordon J. Wisniewski; Secretary, Harry Zirkelbach; Treasurer, Joseph Lavich.

Georgia School of Technology

A successful year was concluded at the meeting of the Georgia Tech Student Branch on May 18. The membership was addressed by James Kukla, President of the Southern Aviation Manufacturing Company of Atlanta. He spoke on the practical problems encountered in airplane and parts manufacture and maintenance.

Included in the year's activities of the Branch was a recent visit to the new Bell bomber plant, where the students were conducted on an excursion through what was termed the largest bomber-assembly building of its type in the world. Other highlights in the student program during the past year were a series of technical films shown at the weekly meetings and student projects on the construction of such items as a flying wing, a low-aspect-ratio model, and a tail-first model.

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Williamsport, Pa.
Wilmington, Del.
Winston-Salem, N.C.
Worcester, Mass.

Yonkers, N.Y.
York, Pa.
Youngstown, O.

Indiana Technical College

After the Spring Term Banquet on May 27, the secretary's report and the treasurer's report were submitted and accepted. The guest speaker, Mr. Schott, who is manager of the Fort Wayne Municipal Airport, gave a talk about postwar aviation and how the average man will be affected by aviation's development. The type of aircraft that will be prevalent after the war was stressed.

Following the talk by Mr. Schott, Mr. Lowry, the faculty adviser of the Branch gave a few words of advice and warning to those new graduates who are preparing for employment in industry. He recounted his own experiences in the world of industry after graduating from Indiana Technical College some years ago.

After these speeches, nine members who are graduating at the end of the term gave their impressions of life at the college and told where they were planning to take up their future work.

Purdue University

The first meeting of summer semester was held May 13, 1943, in the West Faculty Lounge of the Purdue Memorial Union. Prof. K. D. Wood will be the Honorary Chairman for the ensuing term.

The following new officers were elected: William Fleming, Chairman; Dan Pliske, Vice-Chairman; Robert Essig, Secretary-Treasurer.

A short business meeting was held. It was decided to increase the dues this semester to $1.25 in order to have a banquet in honor of the graduating seniors at the close of the semester. A short discussion of future meetings followed, involving an extended summer program.

The second meeting of the semester was held in the Mechanical Engineering Building on June 10. Two short subjects titled *News of the Week* and *Paratroops* were shown. At the business meeting that followed, new membership applications were accepted.

University of Oklahoma

On May 19, 1943, a meeting was held at which the films *Aircraft Identification* and *Aerodynamics* were shown.

The following new officers were elected at the business meeting. Chairman, Harrison Cobb; Vice-Chairman, Kenneth Goin; Secretary-Treasurer, Frances Witten.

At a meeting on June 2, 1943, the films *Keep 'Em Flying* and *Plexiglas* were shown. Following the showing of the films, the Rohm and Haas Company representative gave a short talk on Plexiglas.

A committee was appointed, with Tom Higgins as Chairman, to prepare an exhibit for the annual University Activities Festival.

University of Southern California

An organization meeting of this new Student Branch was held May 31, 1943. The by-laws suggested by the Institute were accepted, and it was decided to leave open the matter of dues and regular meetings until the fall quarter.

The following officers were elected to carry over until the first regular meeting next fall: Robert DeVault, Chairman; Paul Browne, Vice-Chairman; Richard Andrews, Secretary-Treasurer.

Only one meeting was scheduled for the present term, June 4, at which the showing of films was planned.

News of I.A.S. Members

Glenn D. Angle has been made the editor of *Aerosphere*.

Edward Bedrosian is now an aerodynamicist for Hughes Aircraft Company.

Rex B. Beisel has been appointed General Manager of the Chance Vought Aircraft Division of United Aircraft Corporation. He is also the Engineering Manager of the same Division.

James A. J. Bennett is the new Principal Technical Officer for the British Ministry of Aircraft Production.

Vincent J. Berinati, formerly Chief of Structures for the Bristol Aircraft Division of United Moulded Products Corporation, was appointed Structures Engineer of the Aeronca Aircraft Corporation.

Charles O. Cary has joined the Alaska Star Airlines as Assistant Superintendent of Operations.

Charles H. Christenson recently became associated with the Fleetwings Division of Kaiser Cargo, Inc., in the capacity of Design Engineer.

George W. DeBell, formerly Chief Engineer of the Thomas Mason Company, is now an independent Consulting Engineer.

Epaminondas J. Demas was appointed Field Engineer of the Lockheed Aircraft Corporation.

Edward F. B. Dunford is now a member of The Glenn L. Martin Company's Experimental Turret Development Group. He was formerly a Design Engineer for Noorduyn Aviation Ltd., Canada.

Oliver Fraser, Jr., has become an industrial engineer for the Ryan Aeronautical Company, San Diego, Calif.

Carl A. Frische has become Chief Research Director of the Sperry Gyroscope Company.

Richard C. Gazley is now the Executive Engineer of The Cleveland Pneumatic Tool Company.

Carl E. Hall, formerly with the Goodyear Aircraft Corporation, has been appointed Stress Analyst for the Vega Aircraft Corporation.

Benarthur C. Haynes has been promoted to Senior Meteorologist of the U.S. Weather Bureau.

Robert A. Hintermister, Engineer, is now connected with the United Aircraft Service Corporation.

Evert C. Hokanson has been appointed Senior Maintenance Engineer of the Whiting Corporation's Aviation Division.

Sherman H. Lee, formerly with the Waco Aircraft Company, is now an Engineer for the Christopher Aircraft Company.

Major Flavius E. Loudy has been assigned to Consolidated Vultee Aircraft Corporation as Assistant Army Air Forces Resident Representative.

Alfred Marchev was elected Executive Vice-President of the Republic Aviation Corporation, having formerly been Vice-President and General Manager.

Charles J. McCarthy was promoted from General Manager of Chance Vought Division of United Aircraft Corporation to Vice-President, with general supervision over airplane activities.

Donald C. North, Jr., has left his work as Stress Analyst with The Glenn L. Martin Company to become an Ensign in the United States Coast Guard Reserve.

Arthur E. Raabe is now Vice-President and Group Executive of Bendix Aviation Corporation. His previous title was Assistant General Manager of Pioneer Instrument Division.

Arthur E. Raymond is a new member of Douglas Aircraft Company's Executive Committee. Mr. Raymond is Vice-President in charge of Engineering for that Company.

Hugh S. Robinson, Project Engineer for the Bendix Aviation Corporation, has entered the U.S. Navy.

Igor I. Sikorsky has won the award for the Sixth Annual American Design Competition.

Robert D. Speas has been made Assistant to the Vice-President of Engineering of American Airlines, Inc.

Athelstan F. Spilhaus is on military leave of absence from his position as Professor and Chairman of the Department of Meteorology, New York University. He has been commissioned a Captain in the U.S. Army Air Corps.

Russell W. Thaw, formerly Chief Test Pilot for the Airplane Division of Curtiss-Wright Corporation, is now Director of Flight for the General Motors Corporation, Fisher Cleveland Aircraft Division.

Nathan F. Vanderlipp was elected a Director of the Bellanca Aircraft Corporation. He was formerly Manager of Canadian Vickers Ltd.

Edwin C. Walton has been appointed Aircraft Representative of the "Harriman Mission" to coordinate the aircraft production of the United Kingdom and of the United States. He is now stationed at the American Embassy in London.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Anderson, Newton Holiday, B.S. in M.E.; Supervisor, Educational Dept., Douglas Aircraft Co., Inc.

Lundquist, Wilton G., B.S.; Staff Engineer, Wright Aeronautical Corp.

Miller, Louis Crossman, B.S.; Flight Section Supervisor, Wright Aeronautical Corp.

Kallis, Felix, Chief Aero. Engineer, Phoenix Div., Southwest Aircraft Corp.

Outman, Harlan Vernon, Jr., B.S. in Ae.E.; McDonnell Aircraft Corp.

Elected to MEMBER Grade

Bancroft, Nicholas, B.S. in M.E.; Experimental Test Engineer, Pratt & Whitney Div., United Aircraft Corp.

Birk, Paul M., B.S. in M.E.; Design Engineer, Airplane Div., Curtiss-Wright Corp.

Bullard, Lyman A., Jr., B.S. in Ae.E.; Head of Flight Test Dept., Chance Vought Aircraft Div., United Aircraft Corp.

Crandall, Lee Walter, M.S. in C.E.; Engineer, Hoosier Aircraft Co., Inc.

Dedon, William Wise, B.Ae.E.; Structures Engineer, Douglas Aircraft Co., Inc.

Denke, Paul Herman, M.S.; Stress Analyst, Douglas Aircraft Co., Inc.

Elliott, Donald James, B.S. in M.E.; Salvage Engineer, Boeing Airplane Co.

Falbaum, Sanford, B.Ae.E.; Asst. Project Engineer, Consolidated Vultee Aircraft Corp.

Flint, Edward Francis, M.S. in M.E.; Aircraft Instrument Designer, Bausch & Lomb Optical Co.

Forsythe, William Rowe, Ph.D.; Captain, U.S. Army Air Forces.

George, Thomas Carl, B.S. in M.E.; Flight Test Engineer, Vega Aircraft Corp.

Greene, William Lewis, B.S. in A.E.; Chief Engineer, Engineering & Research Corp.

Helmholz, Robert Henry, B.S. in M.E.; Asst. Director of Wind Tunnels, Bureau of Aeronautics, Navy Dept.

Johnson, John Aldridge, S.B. in Ae.E.; Jr. Structures Engineer, Lockheed Aircraft Corp.

Kinsey, Deryl Keith, Electrical Staff Engineer, Consolidated Vultee Aircraft Corp.

Komorn, Marck Bernard, M.S. in M.E.; Engineer, Matam Corp.

Kraft, Herman Theodore, Chief Exp. Engineer, The General Tire & Rubber Co.

Kullas, Albert John, M.S. in C.E.; Stress Engineer, The Glenn L. Martin Co.

London, Albert, A.B. in Physics, Assoc. Aero. Engineer, C.A.A.

London, Lionel, A.B., B.S.; Stress Analyst, A. O. Smith Corp.

Magee, Jerome B., B.S. in Ae.E.; Research Engineer, Bell Aircraft Corp.

Meade, Joseph Frederick, Pres. & Gen. Mgr., Mercury Aircraft, Inc.

Muller, George John, Engineer, Taylor Fibre Co.

Pfeiffer, Paul Orrin, B.S.; Asst. Exp. Engineer, The General Tire & Rubber Co.

Reimer, Ray, Engineer, Northrop Aircraft, Inc.

Runkel, Henry Charles, S.B. in Ae.E.; Asst. Project Engineer, Airplane Div., Curtiss-Wright Corp.

Serrell, Peter Van Horne, M.S. in M.E.; Designer & Company Rep., Calif. Inst. of Tech.

Sogard, Ralph Hoye, M.E.; Flight Test Engineer, Goodyear Aircraft Corp.

Street, William George, B.A.E.; Chief Flight Test Engineer, The Glenn L. Martin Co.

Weibel, Emil Edwin, Ph.D.; Asst. Prof., Univ. of California.

Transferred to MEMBER Grade

Belsley, Steven Eric, M.S. in Ae.; Assoc. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Polowniak, Emil A., Design Engineer (Armament), Emerson Electric Co.

Rios, Robert, A.A. in Ae.E.; Sr. Service Engineer, Vega Aircraft Corp.

Strom, Gordon H., M.S. in Ae.E.; Instructor in Aero. Engineering, Daniel Guggenheim School of Aeronautics, New York Univ.

Wolcott, Fred Wellington, B.S. in Ae.E.; Flight Test Engineer, El Segundo Plant, Douglas Aircraft Co., Inc.

Elected to Industrial Member Grade

Armstron, George Simpson, C.E. in M.E.; President, George S. Armstrong & Co., Inc.

Ayling, Harold Oliver Keith, Author, Aviation Writer.

Ferguson, Malcolm Philip, M.E.; Vice-Pres., Bendix Aviation Corp.

Harris, Joseph Sanford, Asst. Manager, Aviation Dept., Shell Oil Co., Inc.

Hobelmann, Alfred Herman, M.E.; Asst. Vice-President, Walter Kidde & Co., Inc.

Miller, Herbert F., Asst. Army Air Forces Inspector in Charge Fisher Body Div., General Motors Corp., Army Air Forces Matériel Command.

Rogers, Russell Fladger, Manager, AERONAUTICAL ENGINEERING REVIEW, Institute of the Aeronautical Sciences.

Transferred to Industrial Member Grade

Graham, William Henry, Jr., M.A.; Publications Officer, Capt., U.S. Army Air Forces.

Elected to Technical Member Grade

Ballard, Warren Morris, Engineer, Hoosier Aircraft Co.

Birnbaum, Arnold, B.S. in C.E.; Stress Engineer, Eastern Aircraft Div., General Motors Corp.

Boneberg, Harold Anthony, Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

Burnside, William Keeling, B.S. in M.E.; Stress Analyst, Goodyear Aircraft Corp.

Caramihas, Andrew T., B.S.; Stress Analyst, Goodyear Aircraft Corp.

Curtis, Lloyd Graham, Sr. Engineer, Design Engineering, Goodyear Aircraft Corp.

Gildea, David Jerome, M.S.; Asst. Prof. of Aero. Engineering, The Pennsylvania State College.

Gollmer, Carl Edward, B.S. in M.E.; Engineer, Consolidated Vultee Aircraft Corp.

Guss, Marvin, Engineer, Waco Aircraft Co.

Kirchler, Lewis, Layout Engineer, Boeing Aircraft Co.

Larrabee, Elmer Eugene, B.S.; Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

Marts, Joseph B., Jr., Engineering Draftsman, Bell Aircraft Corp.

May, Richard David, B.S. in M.E.; Test Jig & Equipment Designer, Chance Vought Aircraft Div., United Aircraft Corp.

McAleavey, Frank Leo, Engineer, Structures Dept., Cessna Aircraft Co.

Milbank, Jeremiah, Jr., B.A.; Ensign, U.S.N.R.

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Pelletier, Hector Emil, B.A.; Test Jig & Fixture Designer, Chance Vought Aircraft Div., United Aircraft Corp.

Posever, Felix Charles, Stress Analyst, Aircraft Div., York Research Corp.

Rosman, Fred J., Elec. Eng., Sikorsky Aircraft Div., United Aircraft Corp.

Sarginson, Fred Thomas, B.S. in M.E.; Research Engineer, Bell Aircraft Corp.

Smith, Norman Yost, B.S. in Ae.E.; Jr. Stress Analyst, Consolidated Vultee Aircraft Corp.

Winship, Frank Eugene, Service Engineer, McDonnell Aircraft Corp.

Wulf, Norman, B.S. in C.E.; Structural Test Engineer, Boeing Aircraft Co.

Transferred from Student to Technical Member Grade

Allers, Harry Robert, B.S. in M.E.; 2nd Lieutenant, Temporary Adjutant, U.S. Army Air Forces.

Balsley, Philip Forelich, Liaison Engineer, Bell Aircraft Corp.

Blomer, Charles Ignatius, B.S. in Ae.E.; Ensign, U.S.N.R.

Bonvallet, Leland Wayne.

Bowman, Willis Samuel, Jr., A.B.; Aero. Engineer, North American Aviation, Inc.

Canvasser, Marvin Alexander, B.S. in Ae.E.; Jr. Engineer, Continental Aviation & Engineering Co.

Carll, Don Kenneth, B.S. in A.E.; Sr. Engineering Asst., Vega Aircraft Corp.

Classen, David Mills, B.S. in Ae.E.; Weight & Balance Engineer, Airplane Div., Curtiss-Wright Corp.

Climo, James Osborn, Installation Engineer (Trainee), Pratt & Whitney Aircraft Div., United Aircraft Corp.

Common, Jack David, Ae.E.; Jr. Design Engineer, Aeronca Aircraft Corp.

Crocker, Benjamin Ballard, S.B. in Ae.E.; Design Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Danforth, Robert Reives, Jr., Ae.E.; Private, U.S. Army Air Forces.

Dickinson, George Frederick, Jr., B.S. in Ae.E.; Design Engineer, McDonnell Aircraft Corp.

Dolin, Philip P.

Downey, James Russell, B.S. in Ae.E.

Ducoffe, Arnold Lionel, B.S. in Ae.E.; Aerodynamicist, Chance Vought Aircraft Div., United Aircraft Corp.

Edelberg, John Roger, B.S.E.; Ensign, U.S.N.R.

Epstein, Herbert Bernard, Ae.E.; Structural Design Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Erisman, Malcolm Manlove, Jr., Designer, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Fry, James William, B.S. in M.E.; Engineer, Taylorcraft Aviation Corp.

Furlick, William J., B.S. in Ae.E.; Aviation Cadet, U.S. Army Air Forces.

Giglio, Carl.

Goodin, Robert Louis, B.Ae.E.; Aviation Specialist, U.S.N.R.

Graham, Arthur, S.M.; Graduate Student, Mass. Inst. of Tech.

Green, Robert N., B.Ae.E.; U.S. Army Air Forces.

Griswold, William George, Jr., Ae.E.; Flight Test Engineer, Consolidated Vultee Aircraft Corp.

Hager, Herbert Frank, B.Ae.E.; Student Engineer, El Segundo Div., Douglas Aircraft Co., Inc.

Harris, Herbert Benjamin, B.S. in M.E.; Jr. Mech. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Hiegel, Arthur Francis, B.S. in Ae.E.; Ensign, U.S.N.

Ivey, Henry Reese, B.S.; Asst. Aero-Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Johnson, Harold Thurston, B.S. in M.E.; Jr. Stress Analyst, Consolidated Vultee Aircraft Corp.

Jones, Samuel, Supervisor, Charge Group, Chance Vought Aircraft Div., United Aircraft Corp.

Kemp, Bennett Lee, B.S. in Ae.E.; Wind Tunnel Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Klein, Leo Alvin, B.S. in Ae.E.; Midshipman, U.S.N.R.

Kozlowski, Adolph Eugene, B.Ae.E.; Student Engineer, El Segundo Div., Douglas Aircraft Co., Inc.

Krull, Charles Herman, B.S. in Ae.E.

Laucher, Richard Grant, Ae.E.; Liaison Engineer, Airplane Div., Curtiss-Wright Corp.

Lewis, Dean M., B.S. in Ae.E.; Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Lorie, Bernard Robert, B.S. in Ind. E.; Jr. Asst. Engineer, Lockheed-Vega Aircraft Corp.

Marks, Melville, B.Ae.E.; Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Mathews, Ward Os, Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Maxwell, John McClintock, Jr., B.S. in Ae.E.; 2nd Lieutenant, U.S. Army Air Forces.

McClendon, Evard Winfield, B.S. in Ae.E.; Draftsman, El Segundo Div., Douglas Aircraft Co., Inc.

Meyerhoff, Leonard, B.A.E.; Jr. Engineer, Curtiss Electric Propellers.

Mooney, Bruce Dale, B.S. in Ae.E.; Engineering Asst., Lockheed Aircraft Corp.

Murray, Harry Ernest, B.S. in Ae.E.; Aerodynamicist, Langley Mem. Aero. Lab., N.A.C.A.

Nesbitt, Edward J., B.M.E.; Structural Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Niskanen, Woodrow Walter, B.S. in Ae.E.; Ensign, U.S.N.R.

Panagos, Peter, B.S. in Ae.E.; Graduate Student & Instructor, Princeton Univ.

Patterson, William Stevens, B.S. in Ae.E.; Engineer, Douglas Aircraft Co., Inc.

Racisz, Stanley Frank, B.S. in Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Renton, Robert Beyer, B.S. in Ae.E.; Jr. Engineer, Continental Aviation & Engineering Corp.

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Graham, Joe Clint, Process Engineer, Boeing Aircraft Co.

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Necrology

Sanford E. Schubiner

Sanford E. Schubiner lost his life in an accident on May 10, 1943, during the performance of his duties as a test pilot at the Louisville plant of the Airplane Division of the Curtiss-Wright Corporation. He was testing cargo airplane that had just been completed, but the cause of the accident was not determined.

Born at Rochester, N.Y., on June 10, 1918, Schubiner graduated from the Monroe High School in that city in 1936 and was awarded the degree of B. Aero. E. by the Guggenheim School of Aeronautics of New York University in June, 1940. He entered the employment of the Curtiss Propeller Division of the Curtiss-Wright Corporation as an engineer in propeller design detail, and in August, 1942, he became Vice-President and Chief Pilot of the Holerman Air Service, Inc. He returned to Curtiss-Wright in March, 1943, as a test pilot, in which work he was engaged at the time of his death.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Research Engineer with training in electrical engineering and physics; experience in development or research on electrical devices and equipment with a major industry; design and aircraft experience desirable; for West Coast employment by essential war industry. Address inquiries to Box 186, Institute of the Aeronautical Sciences.

Engineers with experience in aerodynamics, structures, processes, layout, and leadmen. All military work. If now employed to your full ability on essential war work, release from your present employer will be necessary. Address inquiries to Box 185, Institute of the Aeronautical Sciences.

Aeronautical Engineers urgently needed by Consolidated Vultee Aircraft Corporation, Fort Worth Division, to execute program of extensive development of large aircraft. Applicants must have technical training and not presently employed in essential war industries. Apply direct to 921 Lamar St., Fort Worth, Tex.

Test Pilot, experienced in operation of 1,000-hp., single-engined airplanes by large eastern aircraft-engine manufacturer. Engineering training desirable, but not necessary. Persons employed in war production need not apply. Address inquiries to Box 168, Institute of the Aeronautical Sciences.

Two Assistant or Associate Professors; (a) instructor aircraft detail design and structural layout; (b) instructor preliminary airplane design. Both positions are to fill existing vacancies in the regular staff. Each must have his or her degree in aeronautical engineering together with practical experience in the aircraft industry. Teaching experience desirable. Rank and salary depend upon qualifications. Address inquiries to Dean Robert L. Mann, Spartan College of Aeronautical Engineering, Tulsa, Okla.

AVAILABLE

Aeronautical Engineering Executive, college graduate, aeronautical engineer with twelve years' experience in all phases of aircraft engineering including design, organization, administration, coordination with Government aircraft procuring agencies. Desires responsible executive position. Available July. Address inquiries to Box 187, Institute of the Aeronautical Sciences.

Engineer, long experience in aircraft design and manufacture; specialized training in application of plastics to aircraft manufacturing desires permanent or consulting connection. Address inquiries to Box 188, Institute of the Aeronautical Sciences.

Engineer, Senior Aeronautical and Physicist (Ph.D.), 15 years' experience available as consultant. Address inquiries to Box 189, Institute of the Aeronautical Sciences.

(*Continued from page 95*)

Qu'en est-il de Notre Aviation Suisse? (What About Our Swiss Aviation?) Capt. E. Naef. A study of Swiss aeronautics shows that Switzerland has about 40 aeronautical plants, manned by 20,000 skilled workers, which manufacture propellers, engines, fuselages, wings, landing gears, instruments, and radio equipment.

Concerning the domestic outlook the writer assumes that after the war airplane traffic will be resumed at a rate never envisioned before. If Switzerland wants to get her share of it, she needs not only modern transport planes but also modern airports. To maintain her tourist trade the latter are regarded as absolutely essential. *Protar—Schweizerische Zeitschrift Für Luftschutz*, August, 1942, pages 188–191.

Housing, Transportation Inadequate. The results of a survey on the transportation and housing problems of the aircraft industry are reported. It is stated the findings showed transportation facilities to be inadequate for 12 per cent of the plants and housing facilities inadequate in areas surrounding 44 per cent of the plants. *Wings*, April, 1943, page 439.

Bevel Gears in Aircraft. Part II. Allan H. Candee. The second part of this article contains an analysis of friction losses in gear teeth and comparative gear efficiencies. Computations are worked out mathematically and are explained by sketches and tables.

Sliding of gear profiles is explained, with reference to the velocity of sliding, the amount of sliding in involute teeth, and length of line of action in involute teeth. Friction losses and efficiency are discussed under headings of the effect of contact ratio on load distribution, the lost work of friction on one tooth and the proportional friction loss. Computations for tooth friction in bevel gears are given and the relative friction losses in gear teeth are compared.

It is concluded that the friction loss calculated by the method outlined for a given set of gears will differ somewhat from the true value because of three specific differences that are summarized as: (1) differences in variations of assumed tooth profiles; (2) differences in actual distribution of load; (3) incorrect assumptions of the value of the coefficient of sliding friction and differences in gears with oblique teeth. *Aero Digest*, May, 1943, pages 314, 317, 318, 328, 7 illus.; *Transactions of the A.S.M.E.*, May, 1943, pages 267–277, 28 illus.

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